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Popular Mechanics

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- Test Drives
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90 YEARS OF FLIGHT

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M9 Replaces The Legendary .45 Automatic And Sets New Firepower Standards

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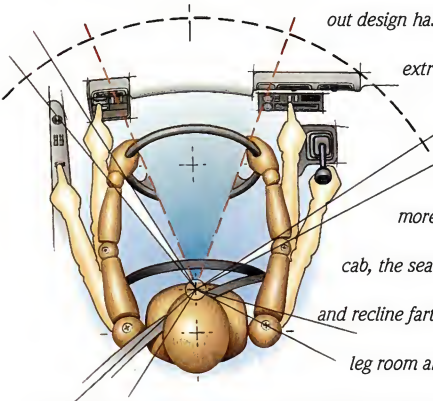

For a free product brochure call 1-800-950-2438.

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December 1993

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PM Popular Mechanics

This one
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It has been a most successful year for **Popular Mechanics** and we are most appreciative to everyone who has contributed and wish everyone a happy holiday and a healthy new year with continued success throughout 1994.

Sincerely,

Bob Dillingham

Bob Dillingham
Vice President & Publisher

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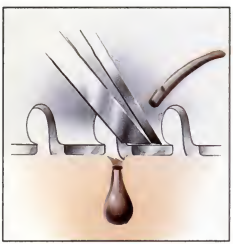
The controls have been made easy to reach, easy to operate and easy to find so you can keep your eyes on the road where they belong. But for all the changes we've made to the inside, we thought it would be an equally good idea to keep the outside from getting in. And that's why the new Chevy S-Series has been designed in a way so you'll hear less of the outside when you're inside. For starters, we've added more sound-deadening insulation to all interior trim panels. Then, sound absorbers were added throughout the dash. Finally, foam sealing plugs have been strategically placed throughout the vehicle to keep things quiet inside. Of course there aren't enough words in the English language that can prove the worth of the new Chevy S-Series that a test drive couldn't accomplish. So come on in and see why everything else is history.™ You won't be disappointed.

The New Chevy S-Series LIKE A ROCK

Announcing several new closeness improvements from Norelco.

A precision groove improves our heads and channels your beard closer.



To improve the "Lift and Cut™ system so it can shave closer.

Enough technology. Note our other closeness improvement.

Norelco did it again. We took our close shave and made it even closer. We've added a precision groove to our floating heads.

A groove that channels your beard, so our "Lift and Cut™ system shaves closer than ever. So much closer, she might want to get closer.

The New Norelco® Razors. Our Closest Shave. Ever.

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NO. 12

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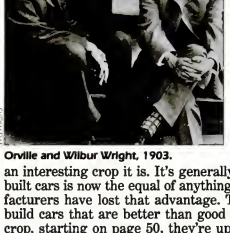
PM cover illustrations by John Berkey
Background: M. Stephenson/Westlight photo

EDITOR'S NOTES

● December 17, 1903, dawned chilly and overcast on the Outer Banks of North Carolina. The wind swirled in from the ocean and out over the sound. But the weather didn't faze Orville and Wilbur. On this day 90 years ago, the Wright brothers were going to change the world. They did, and it did. Now as you look back to that first powered flight, it seems incredible that it was a mere 90 years ago. Since then, look at what has happened: Commercial transports. Jets. Jumbo jets. Stealth fighters. Aircraft carriers. The Concorde. The Space Shuttle. Rockets to the Moon. It's all quite unbelievable, and it has all happened just since that day in Kitty Hawk when two bicycle mechanics tried out their newfangled flying machine. In our cover story this month, beginning on page 25, contributor Michael Patrick chronicles the defining moments in aviation history, the ones that also changed the world forever. . . . **This month, you'll find the second report** on all the new cars for 1994. In October, we reported on the domestic new cars from Motown. This month, we do the imports, and an interesting crop it is. It's generally agreed that the quality of American-built cars is now the equal of anything in the world. So the import-car manufacturers have lost that advantage. To remain competitive, they've had to build cars that are better than good and, judging by our article on the '94 crop, starting on page 50, they're up to the task. Look for more breaking news on new models in our New Cars column which appears in every issue. . . . **Electronics Editor Frank Vizard** seems to spend as much time in the air as he does at his desk. Last month, he flew to both Berlin, Germany, and Tokyo, Japan, in hot pursuit of information about the latest in consumer electronics. His reports appear in this and upcoming issues, although Vizard himself is now home recovering from jet lag. . . . **The Best New Tools For '94.** That's how our Home Improvement editors describe the hand and power tools they write about beginning on page 83. They've been to all the hardware shows, attended all the tool company press previews and digested tons of paper issued by the tool companies to come up with their selections. You'll want to check out the choices of Steve Willson and company. Till next time.



Orville and Wilbur Wright, 1903.

Electronics Editor Frank Vizard in Berlin.

Joe Oldham

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Your symptoms are bothering you, but you're still waiting to see your doctor about your enlarged prostate. Maybe it's time to stop waiting.

Ask your doctor about the prescription medicine PROSCAR®.

(FINASTERIDE)

Finally, a medicine for the treatment of symptomatic benign prostate enlargement

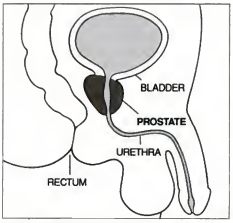
You can't make it till halftime anymore without having to go to the bathroom. You're getting up several times a night to urinate. It's beginning to bother you, but up to now, you've lived with it. The question is, should you?

Until recently, there wasn't a medicine that could help the condition known as symptomatic benign prostate enlargement or BPH. But now there is PROSCAR, the first oral prescription medicine that can actually shrink an enlarged prostate.

However, it is important to know the following: PROSCAR *doesn't work for everyone. Even though the prostate shrinks, you may not see an improvement in urinary flow or symptoms. And you may need to take* PROSCAR *for 6 months or more to see whether it helps you.*

How PROSCAR can shrink an enlarged prostate

As a man ages, a key hormone can help cause the prostate to grow.



The prostate surrounds part of the urethra, the tube that carries urine from the bladder. As the prostate enlarges, it can squeeze the urethra and cause urinary problems.

PROSCAR actually blocks the production of this hormone, so it helps shrink the prostate to a smaller size in many men. As a result, some men treated with PROSCAR experience an increased urinary flow and an improvement in urinary symptoms.

Why you should see your doctor soon

The problem will probably not get better by itself. In many cases, the prostate continues to enlarge and the symptoms may get worse. So if your urinary symptoms are bothering you, consult your family doctor or a urologist and find out if PROSCAR is an appropriate treatment for you. It is also important to have regular checkups. *While benign prostate enlargement is not cancer and does not lead to cancer, the two conditions can exist at the same time.*

Remember, only a doctor can evaluate your symptoms and their possible causes. So don't wait any longer. You may find out that your enlarged prostate can be made into a smaller problem.

For a free, informative booklet, "Every man should know about his prostate," call 1-800-635-4452 today.

TABLETS
PROSCAR® 5mg
(FINASTERIDE)

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Please see patient information on the adjacent page.

MERCK

PATIENT INFORMATION ABOUT PROSCAR* (Prahs-car)
Generic name: finasteride (fin-AS-tur-eyed)

PROSCAR is for the treatment of symptomatic benign prostatic hyperplasia and for use by men only.

Your doctor may prescribe PROSCAR if you have a medical condition called benign prostatic hyperplasia or BPH. This occurs only in men.

Please read this information, as well as the leaflet which accompanies your medication, before you start taking PROSCAR. Also, read the leaflet each time you renew your prescription, just in case anything has changed. Remember, this leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss PROSCAR when you start taking your medication and at regular checkups.

What is BPH?

BPH is an enlargement of the prostate gland. After age 50, most men develop enlarged prostates. The prostate is located below the bladder. As the prostate enlarges, it may slowly restrict the flow of urine. This can lead to symptoms such as:

- a weak or interrupted urinary stream
- a feeling that you cannot empty your bladder completely
- a feeling of delay or hesitation when you start to urinate
- a need to urinate often, especially at night
- a feeling that you must urinate right away.

Treatment options for BPH

There are three main treatment options for BPH:

•Program of monitoring or "Watchful Waiting". If a man has an enlarged prostate gland and no symptoms or if his symptoms do not bother him, he and his doctor may decide on a program of monitoring which would include regular checkups, instead of medication or surgery.

•Medication. Your doctor may prescribe PROSCAR for BPH. See **"What PROSCAR does"** below.

•Surgery. Some patients may need surgery. Your doctor can describe several different surgical procedures for BPH. Which procedure is best depends on your symptoms and medical condition.

What PROSCAR does

PROSCAR lowers levels of a key hormone called DHT (dihydrotestosterone), which is a major cause of prostate growth. Lowering DHT leads to shrinkage of the enlarged prostate gland in most men. This can lead to gradual improvement in urine flow and symptoms over the next several months. However, since each case of BPH is different, you should know that:

•Even though the prostate shrinks, you may NOT see an improvement in urine flow or symptoms.

•You may need to take PROSCAR for six (6) months or more to see whether it helps you.

•Even though you take PROSCAR and it may help you, it is not known whether PROSCAR reduces the need for surgery.

What you need to know while taking PROSCAR

•You must see your doctor regularly. While taking PROSCAR, you must have regular checkups. Follow your doctor's advice about when to have these checkups.

•About side effects. Like all prescription drugs, PROSCAR may cause side effects. Side effects due to PROSCAR may include impotence (or inability to have an erection) and less desire for sex. Each of these side effects occurred in less than 4% of patients in clinical studies. In some cases side effects went away while the patient continued to take PROSCAR.

Some men taking PROSCAR* (Finasteride) may have a decrease in the amount of semen released during sex. This decrease does not appear to interfere with normal sexual function.

You should discuss side effects with your doctor before taking PROSCAR and anytime you think you are having a side effect.

•Checking for prostate cancer. Your doctor has prescribed PROSCAR for symptomatic BPH and not for cancer—but a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). Those checks should continue while you take PROSCAR. PROSCAR is not a treatment for prostate cancer.

•About prostate specific antigen (PSA). Your doctor may have done a blood test called PSA. PROSCAR can alter PSA values. For more information, talk to your doctor.

•A warning about PROSCAR and pregnancy.

PROSCAR is for use by MEN only.

PROSCAR is generally well tolerated in men. However, women who are pregnant, or women who could become pregnant, should avoid the active ingredient in PROSCAR.

If the active ingredient is absorbed by a woman who is pregnant with a male baby, it may cause the male baby to be born with abnormalities of the sex organs. Therefore, any woman who is pregnant or who could become pregnant must not come into direct contact with the active ingredient in PROSCAR.

Two of the ways in which a woman might absorb the active ingredient in PROSCAR are:

Sexual contact. Your semen may contain a small amount of the active ingredient of the drug. If your partner is pregnant, or if you and your partner decide to have a baby, you must stop taking PROSCAR and talk to your doctor. If your partner could become pregnant, proper use of a condom can reduce the risk of exposing her to your semen (discuss this further with your doctor).

Handling broken tablets. Women who are pregnant or who could become pregnant must not handle broken tablets of PROSCAR.

PROSCAR tablets are coated to prevent contact with the active ingredient during normal handling. If this coating is broken, the tablets should not be handled by women who are pregnant or who could become pregnant.

If a woman who is pregnant comes into contact with the active ingredient in PROSCAR, a doctor should be consulted. Remember, these warnings apply only if the woman exposed to PROSCAR is pregnant or could become pregnant.

How to take PROSCAR

Follow your doctor's advice about how to take PROSCAR. You must take it every day. You may take it with or between meals. To avoid forgetting to take PROSCAR, it may be helpful to take it the same time every day.

Do not share PROSCAR with anyone else; it was prescribed only for you.

Keep PROSCAR and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT PROSCAR AND BPH, TALK WITH YOUR DOCTOR. IN ADDITION, TALK TO YOUR PHARMACIST OR OTHER HEALTH CARE PROVIDER.

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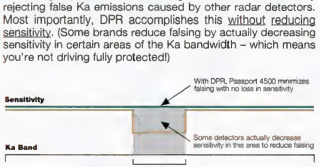
Which Gift Is Guaranteed To Delight Your Favorite Driver?

WRONG answer: The traditional necktie.

RIGHT answer: This extraordinary Passport 4500!

DPR™ The Reason Passport 4500 SuperWide Is Better

Only Passport 4500 SuperWide has Digital Pattern Recognizer (patent pending). DPR is a revolutionary anti-falsing system which digitally selects true Ka signals while simultaneously rejecting false Ka emissions caused by other radar detectors. Most importantly, DPR accomplishes this without reducing sensitivity. (Some brands reduce falsing by actually decreasing sensitivity in certain areas of the Ka bandwidth – which means you're not driving fully protected!)



PASSPORT 4500
SuperWide
RADAR+LASER

This holiday, knock the socks off your favorite driver by giving the gift guaranteed to delight: a Passport 4500 SuperWide radar+laser detector.

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Passport 4500 SuperWide provides all-in-one protection against every type of radar and laser used today.

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Escort was the first to develop a laser detector. We've now taken our patented laser technology one step further by combining it with state-of-the-art radar detection.

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Each Passport comes with a 30-day money-back guarantee which won't begin until December 25, 1993 – even if you buy now. If you're not delighted with your Passport, return it by January 25, 1994 for a refund.

This holiday, choose the *right* gift: give a Passport 4500 SuperWide.

To order, call toll-free:

1-800-433-3487

Passport® 4500 SuperWide $229
plus shipping & handling. Ohio residents add 6% sales tax.

Passport 4200 SuperWide is available for only $199. Call for details.

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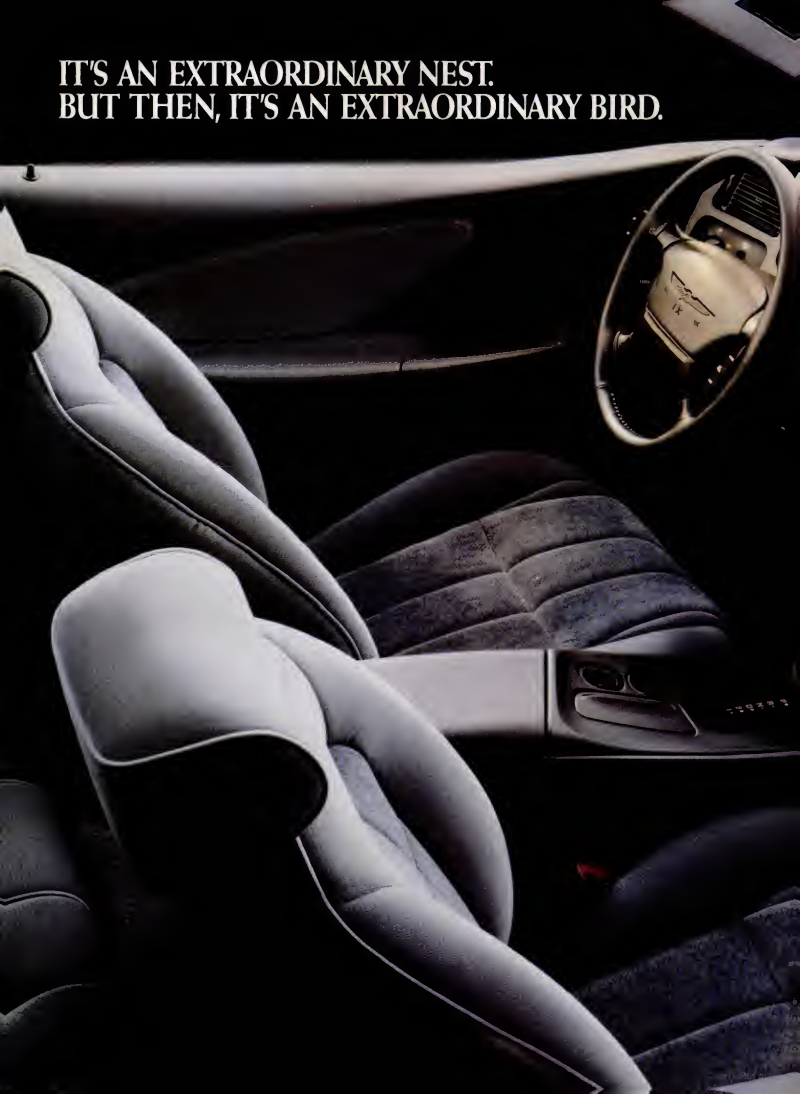

IT'S AN EXTRAORDINARY NEST.
BUT THEN, IT'S AN EXTRAORDINARY BIRD.

THE NEW THUNDERBIRD $16,830.*

Because nothing about this bird is ever ordinary, its new nest had to be more striking, more beautifully appointed than any other.

Along with exceptional design and comfort, the '94 Thunderbird comes with thoughtful features like illuminated door switches and dual cup holders.

Options include an integrated cellular phone and CD changer. Importantly, dual air bags are now standard.**

Of course, the news about the 1994 Thunderbird doesn't stop with its interior. A new optional 4.6L EFI V-8 engine is exceptionally smooth and efficient.***

Handling, performance and beauty have always made the Ford Thunderbird a rare bird. And now, for 1994, it's more extraordinary than ever.

*Manufacturer's suggested retail price excluding destination charges, title and tax. 1994 Thunderbird LX with PEP #155A.
**Driver and right front passenger supplemental restraint system. Always wear your safety belt.
***Est. 18 City/25 Hwy MPG.

HAVE YOU DRIVEN A FORD LATELY?

Ford

LETTERS

Firepower

Your article on collecting firearms states that nonfiring replica weapons are so damn great. Let's get real! Is PM now part of the anti-gun movement? I'll stick with the real thing.

GARY L. LEHMANN
DETROIT LAKES, MN

When I began my subscription to your magazine several months ago, I did so because I consider myself a mechanically inclined individual who found your periodical very compatible with my personality and my interests. To this day, I still feel this way. However, the handgun ad in a recent issue so incensed me that I will not be renewing. When I think of POPULAR MECHANICS, I think of tools used to create, not tools used to kill. I think of inventions used to better lives, not to end them. I think of the future, not of weapons used to prevent it. It is extremely unfortunate that your magazine has chosen to associate itself with such a product. Security at NASA is one thing, a tool of death and despair for criminals is another.

RICK JOHNSON
TALLAHASSEE, FL

In your article on nonfiring replicas, you show a .45-caliber automatic pistol being loaded by a man whose finger is on the trigger. This is a dangerous practice that can be copied by novice gun users and lead to accidental firing. This type of negative safety education seems to be standard throughout much of the media. The trigger finger should be out of the trigger guard unless you want the gun to fire.

COL. RICHARD S. BENNETT
USAF (RET.)
FORT LAUDERDALE, FL

Letters are subject to editing for length, style and format.

Bath Of Freedom

Regarding the picture in Tech Update showing the removal of the Statue of Freedom from the Capitol's dome, the question is: How did they place it up there 130 years ago without a Sikorsky helicopter? This is a 19-ft., 7-ton statue—a lot of rope and pulleys I'll bet.

BILLY HILL
RICHARDSON, TX

Contributing Science Editor Greg Pope replies: *According to the office of the Architect of the Capitol, a steam engine at the dome's base hoisted the statue, which was originally cast in five segments. The same engine then powered a second set of pulleys and winches to lift each segment to the base of the tholos, the ring of columns that caps the dome. Finally, the segments were handcranked one at a time up a pair of inclined rails to the top of the tholos, where they were bolted together. The endeavor took several weeks, ending Dec. 2, 1863.*

Commercial Space

Your Tech Update article on advertising in space incorrectly states that Lawrence Livermore National Laboratory is helping Space Marketing Inc. develop a "space billboard" to carry messages in low Earth orbit. One of our engineers was involved in early discussions about the company's plans, in hopes of finding a convenient platform for space sensors on which he was working. But the Laboratory then decided against actual involvement. No Laboratory funds were spent on the project, and none will be.

JEFF GARBERSON
LAWRENCE LIVERMORE
NATIONAL LABORATORY

Missing Clinics

What happened to Car Clinic in the October issue? Also, why limit Homeowners Clinic to one page? I think these columns are of interest to many readers and should be increased in pages. Don't let down your readers.

TOM EVANS
TUCSON, AZ

Really missed Car Clinic and Service Tips in the October issue. Keep it coming.

DEAN H. HULL
SACRAMENTO, CA

We run Car Clinic in every issue of the magazine except three. May is our annual car care issue, and October and December are our new-car issues. There would be too much car stuff in one issue if we also ran Car Clinic these months. —*Ed.*

Reader Project Of The Month

When I built the corner cabinet featured in your March '93 issue, I used cherry wood rather than ash, and leaded glass rather than clear. Also, due to a shortage of lumber, I used some plywood for the bottom door panels. I didn't have a biscuit cutter, so I substituted dowels for biscuits and for the mortise and tenons. Your plans were very good, and I certainly am pleased with the design. These cabinets utilize space that would not be used otherwise.

STEVE WHITE
MADISON, TN

Possible Dreams

I just got home from Detroit after spending two days at the Possible Dreams exhibit and the Henry Ford Museum, which I class as a number one annex to the exhibit. Over the past few months, I've been in contact with Mary Seelhorst, curator of the exhibit. She has done a fantastic job with the actual exhibit, the articles in PM and the section in the Possible Dreams book. I'm an avid reader of PM and have a collection of approximately 950 issues and annuals dating back to 1902. I found 27 of the weekly issues—a real treasure! If there are any other collectors out there, please send me your names. I am interested in setting up a users group to share and compare information.

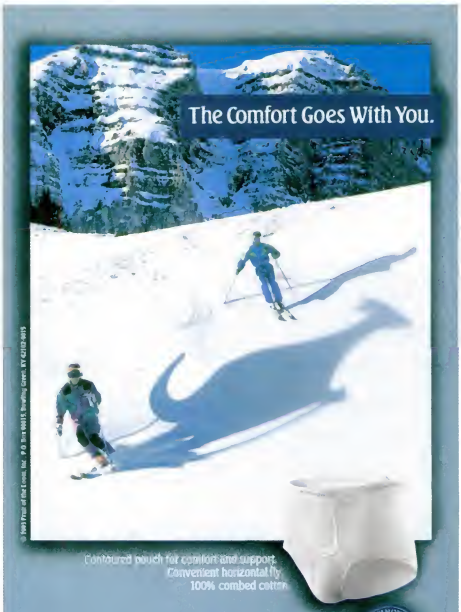
JOHN MUXLOW
22 SOMERSET ST.
DARTMOUTH, NS
CANADA B2Y 1Z1

Perhaps other literature collectors would like to contact Mr. Muxlow.
—Ed.

As a regular subscriber to PM, I enjoyed reading the Possible Dreams articles and was glad to learn that Editor-In-Chief Joe Oldham owns the Schwinn Black Phantom in the exhibit. After reading the 1989 PM article, "Recycling The Classics," about old bicycles, I started looking for old '50s bikes and found out how hard it is to find them. Worse yet, where to get parts when you do find one. Since then, I've discovered many old-bike enthusiasts, publications and swap meets. I now have more than 30 old bikes that my son and I have restored—all due to your article. What a great hobby. Thank you.

CRAIG GRAY
BELLFLOWER, CA

The exhibit "Possible Dreams: POPULAR MECHANICS *and America's Enthusiasm For Technology" will run through Jan. 2, 1994, at the Henry Ford Museum in Dearborn, Michigan. For complete information about museum hours, admission fees, nearby accommodations and attractions, call (800) 343-1929.*



Water Foul

In a recent boating section you wrote, "*As you rip into a full-speed, wheel-lock turn, g-forces slam you into the side of the boat. Your mini-jet throws up a wall of water and you neatly swap ends. As the bow whips across the wake, you straighten the wheel and jam the throttle forward.*" Most drivers of personal watercraft are not aware that there are laws governing the piloting of a vessel. One should not execute such maneuvers on the water any more than one would on the interstate. Drivers of boats and personal watercraft need to improve their safety record or more legislation and less access to our waterways is guaranteed. A magazine with your reputation should provide leadership in this area by addressing the subject of safety when writing an article.

CLEMENS HACKETHAL
RIALTO, CA

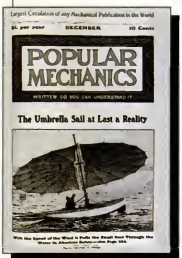
Laws in California are stricter than in other states, but PM always operates boats in a safe and legal manner.
—Ed.

Boating deaths and boating accidents can be tragic. The deaths of the professional ball players who ran their high-speed bass boat into a dock in Florida is an example. Boating education courses, such as those offered by the U.S. Coast Guard, should be mandatory for all boaters. This would help get the message across to the public and would teach boating traffic laws.

DR. A.R. BLANCK
RUTHERFORD, NJ

TIME MACHINE

90 YEARS AGO: DECEMBER 1903

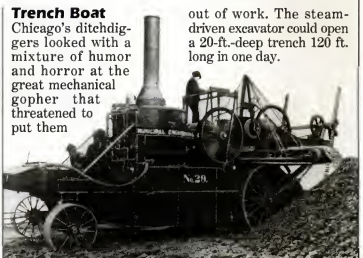


Bumbersailing

Trust the rain-swept British to unfurl a sail in the shape of an umbrella. The so-called Cyclone sail was designed to supercharge yet stabilize a small boat with an oversize sheet of canvas. Behaving like a kite, the huge elliptical sail lifted the boat as it supplied propulsion, keeping the craft on an even keel while it soaked up the added wind. The Thornycroft boatbuilders put a 30-ft.-wide umbrella on a 17-ft. vessel.

Trench Boat

Chicago's ditchdiggers looked with a mixture of humor and horror at the great mechanical gopher that threatened to put them out of work. The steam-driven excavator could open a 20-ft.-deep trench 120 ft. long in one day.



60 YEARS AGO: DECEMBER 1933

Shell Pedallers

Bicyclists were discovering the benefits of streamlining, shielding themselves with teardrop cowlings that mimicked the current locomotive styling. The French, especially cycling champion Marcel Berthet, took it all quite seriously, factoring in wind-tunnel research to sculpt the perfect cowling. The resulting bike shell, dubbed the Velodyne, featured a side door and conning tower and helped Berthet pedal himself to 32 mph.

Gooney's Grandma

Santa Monica, California's Clover Field ushered in a new era when the DC-1 lifted off. Douglas's quick rejoinder to the Boeing Model 247, the DC-1 was faster and roomier. Showing off, a DC-1 pilot switched off one engine and flew 300 miles between Arizona and Albuquerque.

30 YEARS AGO: DECEMBER 1963

One-Track Mind

Would monorails ever make the switch from theme-park curiosities to street-proven transit systems? The debate raged from Seattle to Disneyland. While critics faulted the monorail's complex wheel assemblies and mediocre performance, proponents touted the system's ease of construction and fit into existing right of ways. Even today, monorails have yet to turn the transit business upside-down.

Arch Triumph

St. Louis was gaining a landmark that would rival the Washington Monument or Statue of Liberty for instant-recognition factor. Two years from completion, the Gateway Arch was now rising from the riverfront. Engineering challenges were immense. The two soaring arch legs would never meet if their foundations were misaligned by as little as 1/64th of an inch. And the derricks and welding rigs involved were among the oddest ever built. PM

SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

Kings: 16 mg "tar," 1.1 mg nicotine—av. per cigarette by FTC method.
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Basic

Stellar Performer

One of the most versatile airplanes in the world, the Sopwith Camel has a long history of performance and reliability. The new Pentax IQZoom 115 is destined for the same reputation. The 115 features the longest power zoom lens in the compact zoom camera industry (38-115mm). It also has the ability to switch from normal to panorama photos and back again mid-roll. This allows you to capture both close-up detail and panoramic sights with ease. The 115 also brings together the most advanced light-balancing technology in the compact zoom market, so even if the lighting is difficult, you'll get an extraordinary photo. If you are looking for the ultimate in compact zoom camera performance and versatility, look for the Pentax IQZoom 115.

The 115 is just one of a complete line of IQZoom cameras from Pentax, each designed to be a stellar performer.

Photo taken with Pentax IQZoom 115 camera with zoom set at 115mm.

Photo taken with Pentax IQZoom 115 camera with zoom set at 38mm, panoramic mode.

For best results use Kodak film.

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TECH UPDATE

News Of Tomorrow's Technology Today

PM ILLUSTRATION BY PAUL DAMARE

Rutan Tosses A Curve With His *Boomerang*

MOJAVE, CA—Now taking form in a Scaled Composites hangar is the latest twist in Bert Rutan's mainstream-bucking career. This time it's Rutan's own personal aircraft, draped in secrecy and shaped as radically as anything he's produced.

From the scant information that's been made public about the airplane, the *Boomerang* throws Rutan's twin-boom thinking decidedly off-center. The main boom, just starboard of the plane's centerline, seats five, including the pilot, in a staggered arrangement. The smaller boom holds baggage. Each has a turbocharged 4-cylinder Lycoming engine.

The asymmetrical forward-swept wing only adds to the plane's jarring silhouette. The wing spar penetrates through the interior of the starboard cabin.

The *Boomerang* is supposed to showcase Rutan's new labor-thrifty manufacturing technique that permits components made of composite materials to be solidified together. The process is also said to strengthen structural integrity.

In addition, the plane's avionics—including aircraft systems diagnostics and a GPS-based moving map—reside in a removable, reprogrammable Macintosh PowerBook computer.

Rutan's Boomerang, which could fly as early as this winter, features asymmetrical wing.

Editor/Writer: Greg Pope
Reporters: Philip Chien, Scott Gourley, Sam Katz

Highlights This Month

- **Wet Bus**—Deepest touring submarine yet heads for Martinique.
- **Return Of The LAW**—Original disposable bazooka is back on the beat.
- **Ferry Queen**—Immense channel crosser will carry 1500 at 46 mph.
- **Working Stiffs**—Robots try office jobs, but call in sick.
- **Turbo Chargers**—Gas-turbine engines could power electric cars.
- **Charlotte's Web**—Robotic arachnid will tend Shuttle science.

(More Tech Update on page 16)

TM ILLUSTRATION BY ED VALIGURSKY

Lockheed Joins Launch Club

SUNNYVALE, CA—General Dynamics, Martin Marietta, McDonnell Douglas—each has its piece of the launch-vehicle business. Why not Lockheed Missiles & Space, which has plenty of experience with solid-rocket propulsion?

Why not indeed. Next November, Lockheed will launch the first of its newly developed LLVs (Lockheed Launch Vehicles) from Vandenberg Air Force Base.

The new rocket family is based on the Thiokol Castor 120 motor, which also lies at the heart of Orbital Sciences' Taurus vehicle (see Tech Update, page 17, Jul. '93).

The smallest configuration, the LLV1, will boost 2300 pounds to low Earth orbit. The LLV2, featuring two Castor 120 stages: roughly 5300 pounds. The biggest version, the LLV3, will come with Castor IV strap-on boosters to loft payloads weighing up to 8900 pounds.

As of now, those payloads will come from the Department of Defense or NASA. But small civilian spacecraft, such as future replacements for Motorola's coming Iridium mobile-phone satellites, are likely candidates.

(Left to right) LLV1, LLV3 and LLV2 should fill gap between Pegasus and Delta rockets.

Deepest Tourists Yet

KARLSRUHE, GERMANY—As early as next summer, the world's biggest and deepest-venturing passenger submarine will begin diving off the West Indian island of Martinique.

Built by Bruker Meerestechnik, the 70-ft. *Seamaid TS IV* will hold up to 50 passengers and also deploy a small, camera-carrying remotely operated vehicle.

Electrohydraulic drive, in which batteries supply power to hydraulic pumps that turn the screw, offers extremely reliable propulsion. To compensate for this system's lower efficiency, the sub will carry a whopping 630 kilowatt hours of electricity in its batteries.

Seamaid will plunge to 450-ft. depths, visiting the graveyard of 3-masted square riggers that sank during the 1904 eruption of Martinique's Mt. Pelee volcano.

BRUCE MEERESTECHNIK PHOTO

Construction draws to a close on the 120-ton *Seamaid TS IV*.

Blue Blazer Data Laser

IBM PHOTO

Blue laser can focus on a spot a quarter of the area of a standard infrared disk-writing laser.

SAN JOSE, CA—A reliable blue solid-state laser could revolutionize optical data storage. IBM's Almaden Research Center recently turned such a device on a magneto-optical disk and inscribed data at a density five times that of today's best rewritable optical disk drives.

IBM shined a standard diode laser, which emits infrared light, through a frequency-doubling potassium-niobate crystal. The beam came out blue.

The blue laser has been the Holy Grail of optical engineering because its short wavelength can be focused on a smaller spot for denser data storage.

Engineers must now shrink the device to fit it into personal computers.

Robotic Supersapper

TEL AVIV, ISRAEL—The Israelis pioneered the use of bomb-disposal robots, and their latest device capitalizes on 30 years of experience with terrorist bombs.

Made by Ta'as Israel Industries, the TSR-700 can reportedly handle anything from a booby-trapped bottle to a car bomb to a Scud warhead. The arm gripper can unscrew a bottlecap, lift 300 pounds or tow a 2-ton vehicle.

The arm can also be fitted with a 12-gauge shotgun—ideal for destroying a bomb's detonator. Other options: water cannons, X-ray cameras, even a cellular telephone for hostage-negotiation scenarios.

Israel's National Police, as well as American and foreign agencies, have bought the robot as a security guard as well as a sapper.

TA'AS ISRAEL PHOTO

TSR-700's arm can reach up to 8 ft. guided by TV cameras.

INTRODUCING *MOTOR TREND'S*

"TRUCK OF THE YEAR."

TING IN YOUR OLD

COMFORT AND CONVENIENCE

	DODGE	FORD	CHEVY
The new Dodge Ram has the most total interior passenger/cargo space.	72.1 cu ft	65.6 cu ft	67.8 cu ft
The new Dodge Ram was quieter inside than '93 Ford & Chevy models in on-road tests.[5] (1994 models unavailable for test)	Ram 1500 4x2 5.2L V-8 Auto Highway @ 55 MPH 61.9 Decibels Rough Road @ 55 MPH 66.8 Decibels	F-150 4x2 5.0L V-8 Auto Highway @ 55 MPH 64.6 Decibels Rough Road @ 55 MPH 73.4 Decibels	C-1500 4x2 5.0L V-8 Auto Highway @ 55 MPH 63.8 Decibels Rough Road @ 55 MPH 68.3 Decibels
	Ram 2500 4x2 5.9L Diesel Auto Highway @ 55 MPH 65.6 Decibels Rough Road @ 55 MPH 67.2 Decibels	F-250 4x2 7.3L Diesel Auto Highway @ 55 MPH 67.3 Decibels Rough Road @ 55 MPH 73.6 Decibels	C-2500 4x2 6.5L Diesel Auto Highway @ 55 MPH 67.9 Decibels Rough Road @ 55 MPH 69.4 Decibels
Only Dodge provides a 40/20/40 three-section bench seat with a flip-down Business Console, accommodating a lap top computer, cellular phone, cassettes, etc.	Available	Not available	Not available
Only Dodge provides a behind-the-seat storage system with a divided tray, interchangeable bins and cargo netting.	Available	Not available	Not available
Only Dodge provides flush-mounted front tie downs and horizontal/vertical cargo box bulkhead slots.	Standard	Not available	Not available

READ

POWER AND PERFORMANCE

	DODGE	FORD	CHEVY
Dodge delivers more six cylinder power.	3.9L V-6 MPI 175 hp/230 lb ft torque	4.9L I-6 EFI 150 hp/260 lb ft torque	4.3L V-6 EFI 165 hp/235 lb ft torque
Dodge delivers more V-8 power and torque than comparable small block engines.	5.2L V-8 MPI 220 hp/300 lb ft torque	5.0L V-8 EFI 205 hp/275 lb ft torque	5.0L V-8 EFI 175 hp/265 lb ft torque
	5.9L V-8 MPI 230 hp/330 lb ft torque	5.8L V-8 EFI 210 hp/325 lb ft torque	5.7L V-8 EFI 200 hp/310 lb ft torque
Dodge has the only V-10 engine in the business, with more power and torque than any big block engine.	8.0L V-10 300 hp/450 lb ft torque	7.5L V-8 EFI 245 hp/395 lb ft torque	7.4L V-8 EFI 230 hp/385 lb ft torque
Dodge delivers more hard working torque than any other diesel pickup.	5.9L I-6 175 hp/420 lb ft torque[1]	7.3L V-8 190 hp/395 lb ft torque	6.5L V-8 190 hp/385 lb ft torque
Dodge out-accelerated Ford and Chevy '93 models when total weights were equalized.[2] (1994 models unavailable for test)	Ram 1500 4x2 5.2L V-8 Auto (Loaded) 0-60 10.9 sec 1/4 mi 18.3 sec Loaded & w/trailer 0-55 20.1 sec 1/4 mi 24.5 sec	F-150 4x2 5.0L V-8 Auto (Loaded) 0-60 12.5 sec 1/4 mi 19.1 sec Loaded & w/trailer 0-55 23.6 sec 1/4 mi 25.4 sec	C-1500 4x2 5.0L V-8 Auto (Loaded) 0-60 13.2 sec 1/4 mi 19.6 sec Loaded & w/trailer 0-55 23.8 sec 1/4 mi 25.5 sec
	Ram 2500 4x2 5.9L V-8 Auto (Loaded) 0-60 12.8 sec 1/4 mi 19.4 sec Loaded & w/trailer 0-55 20.6 sec 1/4 mi 24.5 sec	F-250 4x2 5.8L V-8 Auto (Loaded) 0-60 13.3 sec 1/4 mi 19.7 sec Loaded & w/trailer 0-55 21.6 sec 1/4 mi 24.9 sec	C-2500 4x2 5.7L V-8 Auto (Loaded) 0-60 14.0 sec 1/4 mi 19.8 sec Loaded & w/trailer 0-55 22.4 sec 1/4 mi 24.7 sec
Dodge delivered superior diesel fuel economy vs. '93 Ford & Chevy models in actual in-use tests.[3] (1994 models unavailable for test)	Ram 2500 4x2 5.9L Diesel Auto 14.9 MPG	F-250 4x2 7.3L Diesel Auto 12.2 MPG	C-2500 4x2 6.5L Diesel Auto 12.0 MPG

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THIS WHILE SITT

PAYLOAD AND TOWING

	DODGE	FORD	CHEVY
Dodge offers more available payload.	Max 4x2/5,290 lbs Max 4x4/4,885 lbs	Max 4x2/5,125 lbs Max 4x4/3,960 lbs	Max 4x2/5,024 lbs Max 4x4/4,649 lbs
Dodge delivers more available towing.	Max 4x2/13,600 lbs Max 4x4/13,200 lbs	Max 4x2/12,500 lbs Max 4x4/12,500 lbs	Max 4x2/13,500 lbs Max 4x4/13,000 lbs

RIDE AND HANDLING

	DODGE	FORD	CHEVY
Dodge makes 16" wheels and tires standard equipment on all full-size pickups.	Standard 16" tires	Not available on half-ton models	Not available on 4x2 half-ton models

SAFETY

	DODGE	FORD	CHEVY
Only Dodge makes a driver's side airbag standard equipment on every pickup it sells.	Standard driver's side airbag[4]	Standard only on pickups under 8,500 lbs GVW	Not available
Only Dodge offers 4-wheel anti-lock brakes.	Available on 1500 & 2500 models	Not available	Not available

IF LOOKING AT THE
DOESN'T CO
THE RULES HA

TRUCK.

DURABILITY AND RELIABILITY

	DODGE	FORD	CHEVY
Dodge offers a rear step bumper that's lighter, without sacrificing strength.	56 lb step bumper	64 lb step bumper	65 lb step bumper
Step bumper max tongue/trailer weight.	500 lbs/5,000 lbs	500 lbs/5,000 lbs	200 lbs/2,000 lbs
Dodge gives you the only choice of warranties, our Owner's Choice Protection Plan, with the longest powertrain protection.[5]	3/36 Bumper-to-Bumper or 7/70 Powertrain 7/100 Corrosion Perforation	3/36 Bumper-to-Bumper 6/100 Corrosion Perforation	3/36 Bumper-to-Bumper 6/100 Corrosion Perforation
Longest diesel engine warranty.[6]	7/100 Diesel Engine	3/36 Diesel Engine	5/100 Diesel Engine

Data based on information available at time of printing, including some '93 competitive data. See dealer for latest information.

[1]Manual transmission. [2]All runs were done with equal GVWs/GCVWs, which resulted in the Dodge having lighter loads in some instances. Trucks equipped with limited slip differentials & comparable axle ratios. '94 competitive specs vary. [3]Tests conducted by SCORE International and consisted of 1,234 miles of driving over varied real-life terrain and driving conditions, in various load conditions including with equalized total GVWs/GCVWs. Trucks equipped with limited slip differentials & comparable axle ratios. Results valid only vs. '93 Ford & Chevy models. No EPA est. MPG for Dodge tested (over 8500 GVW). Your mileage may vary. [4]Always wear your seat belt for a fully effective airbag. [5]SCORE International average interior sound level tests over highway @ 55 MPH and over rough road @ 55 MPH. '94 competitive models differ. [6]See Dodge's limited warranties, restrictions & details at dealer. Normal maintenance, adjustments & wear items excluded. Warranty provisions vary by manufacturer.

For still more information, call 1-800-4-A-DODGE.

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DODGE RAM THE NEW DODGE

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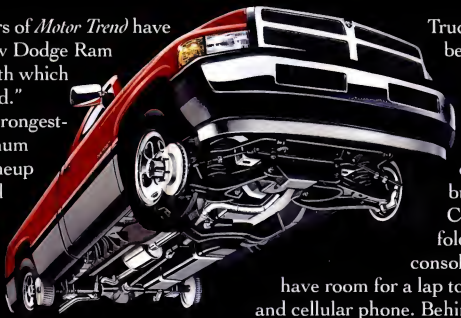
"Dodge Ram Has Created A New Standard By Which Full-Size Pickups Will Be Judged."

-Motor Trend



The editors of *Motor Trend* have called our new Dodge Ram "...a force with which to be reckoned."

With its strongest-in-class Magnum powertrain lineup and high level of safety, we couldn't agree more.

The fact is, Ram has one safety feature no full-size pickup ever had before. A standard driver airbag. And Ram is the only full-size pickup to offer the security of anti-lock brakes at all four wheels.

Take the new Ram for a spin, and you'll enjoy a smooth, comfortable ride. Which is something you may not expect in a full-size pickup.

Trucks have always been workhorses. Now they're also a convenient place to conduct business.

Choose Ram's fold down center console, and you have room for a lap top computer and cellular phone. Behind the seats, there's plenty of room for the convenience of available interchangeable bins, a divided tray and cargo netting.

We've provided Ram with an extra measure of protection, too – by using more exterior galvanized steel than any other full-size pickup on the road, and making substantial use of anti-chip materials.

Here's one last point to consider: Ram also has more maximum payload than other full-size pickups. Not to mention the terrific amount of weight it carries with the editors of *Motor Trend*.

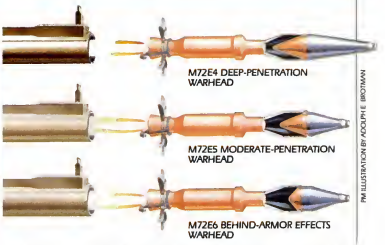
The Rules Have Changed.

Dodge Ram

The New Dodge
A DIVISION OF THE CHRYSLER CORPORATION

New Respect For The LAW

TALLEY DEFENSE SYSTEMS PHOTO



PM ILLUSTRATION BY ADOLPH E. BROTMAN

New series of LAW one-shot rocket launchers comes with choice of warheads for different battlefield targets.

MESA, AZ—After 20 years of service with the Army, the M72 Light Anti-armor Weapon was ready to retire in the early 1980s, as the well-regarded Swedish-made M136 took over as the frontline throwaway rocket launcher.

Now the long arm of the LAW has returned, with an improved gunner-type launcher sight, longer-range rocket motors and a trio of warheads.

The new LAW is as simple as its predecessor. The changes are all inside. The 66mm rockets are lighter than those launched by the M136. One variant can punch through a foot of armor, one delivers the impact of the original M72A3 warhead, while the third has been tailored for behind-target effects. This latter model is designed to knock out spaced-armor configurations, or to throw out fragmentation against reinforced-concrete targets such as bunkers.

The original Norwegian LAW maker, A/S Raufoss, has been joined by Talley Defense Systems and an international consortium to manufacture the "E"-model upgrades. Formal U.S. type classification is expected by the end of this year. Navy Seals will be among the first new users.

Hailing Taxi2000

MARLBOROUGH, MA—Personal rapid transit (see Tech Update, page 26, Oct. '92) looks like a go: Chicago's Regional Transportation Authority has selected the Taxi2000 concept for demonstration.

The system will feature podlike driverless cars that arrive and depart from stations on demand and proceed nonstop to destinations. In-vehicle switching systems allow the cars to bypass intermediate stops. Propelled by linear motors, the vehicles will seat one to four passengers.

Raytheon is the big winner and will construct the prototype of the Taxi2000 vehicle, developed by Boston University professor Edward Anderson. The company will also build a ½-mile test track outside Boston over the next three years. Then the RTA will judge whether to install a 3-mile line in Rosemont, Illinois, to connect hotels, offices, the O'Hare Expo Center and a local rapid-transit line.

RAYTHEON PHOTO AND ILLUSTRATION

Anderson's Taxi2000 vehicles will first come to life outside Boston, then Chicago.

Fastest Mega-Ferries Ever

STOCKHOLM, SWEDEN—They're as big as football fields, juggernauting through the waves at 46 mph. And they're coming to tame the Irish Sea.

The two new ships, to be built by Finnyards for the Swedish line Stena, will be the fastest ferries ever built this big.

Massive aluminum-hulled catamarans—dubbed HSS for high-speed sea service—the boats will haul 500 passengers and 375 cars at once. Compare that with the 400 passengers and 80 cars on the equally speedy Hoverspeed Seacats. Buses and tractor-trailers will also roll on and off the ferries.

The propulsion: four gas-turbine engines, two in each hull, powering steerable waterjets.

The first of the ferries will go into service in 1995 between Holyhead, Wales, and Dun Laoghaire, Ireland, cutting the 4-hour crossing time in half.

But Stena won't say whether the second craft will take on the rival Seacats and the Channel Tunnel, which is due to open next year.

STENA AB PHOTO

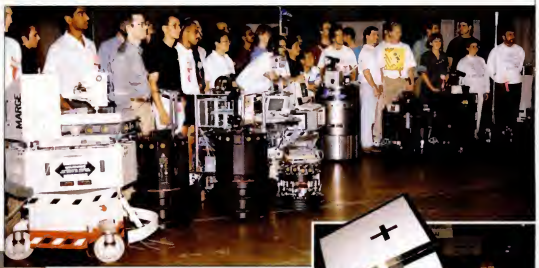
HSS ferry will combine 40-knot speeds with voluminous capacity and seaworthiness.

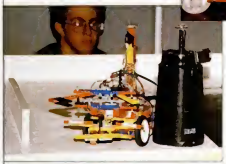
(More Tech Update on page 18)

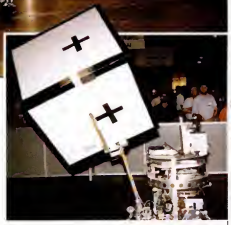
Robots Versus The Office

WASHINGTON, DC—This year's robot competition—an annual event staged by the American Association For Artificial Intelligence (see Tech Update, page 30, Dec. '92)—pitted the automatons against the most unforgiving of American environments: the workplace.

The contest attracted 14 competitors, the venue a set of desks, chairs and file cabinets surrounded by white cardboard boxes.







Contestants line up for "valiant effort" awards, after finding the coffeepot (left) and rearranging the office (right) proved too difficult.

WHITEBRANCH POWERSTOCK PHOTOS

First, the robots had to weave through the office to an open door. They then had to deliver the coffee, finding their way to a coffeepot and returning to a given location. Finally, they were tasked with rearranging the office by lifting and shifting cardboard boxes.

This year, no one robot really shone. In the first event, robots from Stanford University, Cal Tech, Stanford Research Institute and Carnegie-Mellon all escaped the office quickly, the first two using machine vision, the latter two simply roving their way out. But the second and third events stumped everyone's sense of spatial reasoning. Hence the frequent refrain: "Wait till next year."

Turbo-Electric Car Engines

LONDON, ENGLAND—Back in the 1950s and '60s automakers eyed the gas turbine as an alternative to the piston engine, only to be disappointed by its thirst for fuel, power lags and complex direct-drive gearing.

But engineers at Imperial College believe they can pass these roadblocks by using a small gas turbine to drive the generator, or alternator, of an electric vehicle.

Such an arrangement would require an alternator capable of handling speeds of 75,000 to 125,000 rpm. The researchers have patented a novel high-speed generator, in which disc-shape magnetic rotors, spun by the turbine's output shaft, interleave with stationary stators.

LONDON PICTURES SERVICE PHOTO

Small turbine drives high-speed disc alternator for hybrid electric vehicles.

Packed with rare-earth magnets, the discs can generate intense magnetic flux to be soaked up by the stator.

Right now the engineers are working on a 50-kilowatt version suitable for portable power generation.

Sweden's Parking Jukebox

HALLSBERG, SWEDEN—A robotic parking lot developed by Stockholm-based Sky Park Construction may spell doom for Sweden's parking-lot attendants.

Robotic Sky Park uses robotic trolley to pigeonhole cars automatically.

SKY PARK CONSTRUCTION ILLUSTRATION

The 112-space 5-story building, now operating at a major railway junction, also takes up less than half the volume of a conventional garage.

You simply steer your Saab into an entrance module, pull a ticket from a dispenser and walk away.

Inside, once the gate closes, a computer-controlled trolley rolls in beneath your car's wheels and trundles it horizontally and vertically, depositing it in an empty stall.

On your return, you plug your ticket back into the machine, and the machinery works in reverse. The entire process takes about a minute.

A Sky Park comes equipped with redundant computer, emergency generators in case of power failure and video cameras to prevent hanky-panky.

(More Tech Update on page 20)

I Just Bought These Great Sounding Surround-Sound Speakers.

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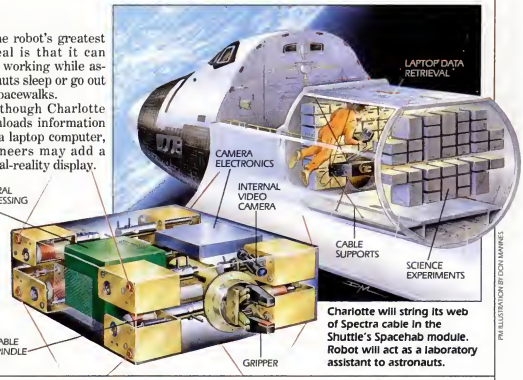
Charlotte's Web

HOUSTON, TX—When the Shuttle carries Spacehab, a pressurized cargo-bay module used as extra laboratory space, crew members have to scramble to keep track of experiments in progress. But soon a robot named Charlotte, under development at McDonnell Douglas Aerospace, will assume a lot of this workload.

Like the spider in the children's book, Charlotte operates in a web—eight cable supports strung to the corners of Spacehab. By winching in and releasing opposite pairs of cables, Charlotte will be able to flit back and forth across a bank of experiment modules, flipping switches and viewing displays.

The robot's greatest appeal is that it can keep working while astronauts sleep or go out for spacewalks.

Although Charlotte downloads information into a laptop computer, engineers may add a virtual-reality display.



Charlotte will string its web of Spectra cable in the Shuttle's Spacehab module. Robot will act as a laboratory assistant to astronauts.

PM ILLUSTRATION BY DON MAYNES

Amtrak's Diesel Dynamo

ERIE, PA—For the first time in more than 40 years, Amtrak has a new diesel locomotive designed expressly for American high-speed passenger service.

GE's AMD-103 features monocoque construction for both aerodynamics and crash safety.

GE PHOTO

Unlike the chunky locomotives adapted from freight designs, the General Electric AMD-103 features a lightweight, European-style monocoque outer shell. Integral with this frame is a compartmented fuel tank designed to limit spillage during an accident.

The 4000-hp, 103-mph locomotive also features extensive microprocessor control and diagnostics for electric power, its 16-cylinder turbocharged engines and other systems. The engineer rides in a cabin outfitted like a command center.

The first AMD-103s are now pulling AutoTrains between Virginia and Florida.

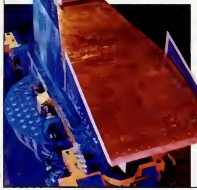
Scramjet Countdown

HAMPTON, VA—Despite the indefinite postponement of the X-30, the National Aero-Space Plane program lives on in the form of technology demonstration.

One of the latest developments is the arrival of a 30% scale model of a scramjet, built by Pratt & Whitney, at NASA's Langley Research Center. Known as the Concept Demonstration Engine (CDE), it's the largest scramjet model NASA has ever tested.

Though not built of flight-worthy materials, the copper model is a functioning engine and will burn hydrogen during wind-tunnel tests. The CDE will get a workout in Langley's 8-Foot High-Temperature Tunnel, where it will be blasted at speeds up to Mach 8.

Engineers have recently upgraded the facility, adding an oxygen replenishment system to accommodate engine-propulsion tests.

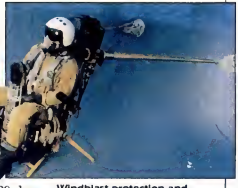


The Concept Demonstration Engine is the largest scramjet model NASA has ever tested.

NASA PHOTO

Russia's Bailout Seat

WRIGHT-PATTERSON AFB, OH—A Russian ejection seat in an American fighter? You never know. The Air Force and Navy are now checking out the K-36D, which first drew attention during a successful low-altitude bailout from a MiG-29 during the 1989 Paris Air Show.



Windblast protection and stabilizer booms contribute to K-36D's survivability.

AMERICAN PHOTO

The seat, made by Zvezda Design Bureau, is standard equipment on top Russian combat jets. While the American ACES II is rated for speeds up to 690 mph, the K-36D claims survivable ejections at 870 mph.

Key features: a perforated windblast protector between the pilots legs and twin rear-mounted stabilizer booms that keep the seat vertical during descent.

The U.S. military analysis of the seat will involve rocket sleds, windblast tunnels, ejection towers and a MiG-25—all using manikins.

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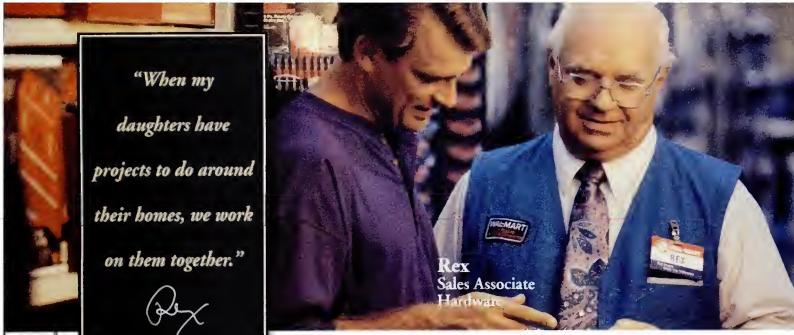

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HAVE YOU DRIVEN A FORD LATELY?

Popular Mechanics
DECEMBER 1993

90 YEARS OF FLIGHT

In celebration of the anniversary of the Wright brothers' triumph, we spotlight aviation's defining moments.

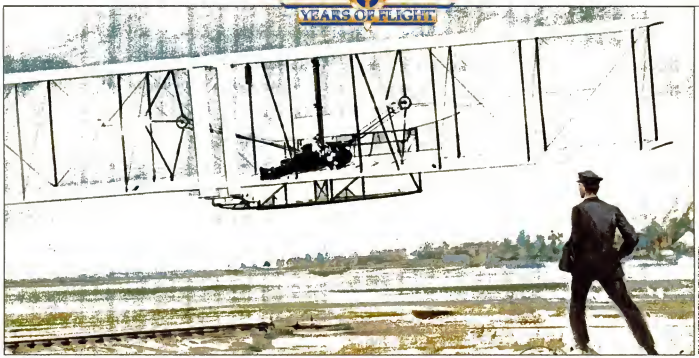
BY MICHAEL PATRICK

• "Success. Four flights Thursday morning all against 21-mile winds. Started from level with engine power alone. Average speed through air 31 miles. Longest 59 seconds. Inform press. Home Christmas."

Thus read the telegram sent on December 17, 1903, from two bicycle-shop owners to their father in Dayton, Ohio. As with so many epochal events, the Wrights' achievement went largely unheralded at the time, the press wary of bogus flying-machine claims, the brothers keeping it close to the chest as they quietly chased their patents.

But as the decades flew by, and aviation's pioneers set milestone after milestone, the Wright flight has taken on a lofty significance as the starting point for a parade of technological triumph. The parade winds through storied settings—Seattle, Paris, Edwards Air Force Base and Roosevelt Field, Long Island, among them. So follow along as we retrace the route that began 90 years ago on a bleak sandy dune named Kitty Hawk.

M. STEPHENSON/WESTLIGHT PHOTO



PM ILLUSTRATION BY JOHN BERKEY

First Controlled Powered Flight

December 17, 1903

Responding to the signal—a flag fluttering from a wooden shed—the five men from nearby Kill Devil Life Saving Station had come to see what the Wright brothers were up to today. Orville had focused a camera on the starting rail and asked lifeguardsman John Daniels to click the shutter if the flying machine rose.

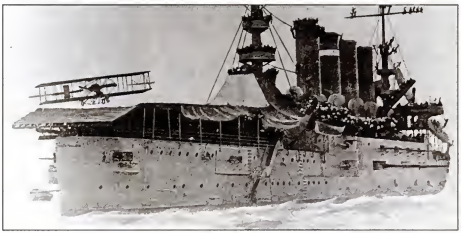
The brothers then started their homebuilt engine and let it growl in the bitter cold wind for a few minutes. Wilbur's attempt to take off three days ago had failed, so now it was Orville's turn.

At 10:35 am, he lay prone on the lower wing and let the restraining rope slip. The *Flyer* moved. Wilbur broke into a run along the craft's right side, steadying the wing. Suddenly the whole machine lifted from the rail. For 12 long seconds, the *Flyer* wobbled and snaked 10 ft. above the dunes, landing 100 ft. away. Daniels had snapped the shutter, freezing in an instant what mankind had sought for millennia.

Advent Of The Aircraft Carrier

November 14, 1910

Today's carrier battle group traces its ancestry to an improvised platform on the foredeck of the U.S. Navy cruiser *Birmingham*—and a pilot, named Eugene B. Ely, who worked for aviation pioneer Glenn Curtiss. The *Birmingham* had weighed anchor in Hampton Roads, Virginia, when Ely drove a Curtiss biplane off the cruiser's bow. After nosing seaward and clipping the water, the Curtiss flew 2½ miles to Willoughby Spit.



BETTMANN ARCHIVE PHOTO

Two months later, Ely closed the loop by taking off from San Francisco and alighting on the USS *Pennsylvania*. The Curtiss came to rest when its tailhook snared sandbagged lines stretched across the wooden deck.

Despite Ely's successful demonstrations and the service's initial interest in flying sea scouts, a dozen years passed before America commissioned its first aircraft carrier, the USS *Langley*.

ONDEI PHOTO

First Scheduled Airline

January 1, 1914

A.C. Pheil, mayor of St. Petersburg, Florida, stepped into the single passenger seat. Tony Jannus throttled up his 75-hp Roberts engine. And the wooden-hulled *Benoist XIV* flying boat rumbled out of the yacht basin and took off for Tampa, 20 miles east.

The St. Petersburg-Tampa Airboat Liner, the world's first point-to-point airline, was in operation. It was the brainchild of St. Louis industrialist Thomas Benoist, who also designed and built the 2-seat flying boat. The airline folded three months later, at the close of the tourist season, after reportedly carrying 1200 passengers—including humorist Will Rogers—at $5 a head.

PM ILLUSTRATION BY ATILA NEJA

Fall Of The Red Baron

April 21, 1918

From the Great War's outset, aerial combat had a mystique, the pilots lone knights jousting in a clean blue field. But the truth of the endeavor was killing, and none was more accomplished at it than Manfred von Richthofen.

Trained for the cavalry, the young German saddled up on a different horse—his red Fokker Dreidecker. By early 1918, he had scored his 80th victory.

On the day of von Richthofen's death, his Flying Circus unit was engaged in a dogfight when one of the Allied planes broke for home. Von Richthofen zoomed in for the kill. Suddenly gunfire raked his cockpit. Dispute simmers to this day as to whether Canadian Capt. Roy Brown or a ground machine-gunner put the bullet in the Baron's heart.

Origin Of Air Mail

May 15, 1918

BETTMANN ARCHIVE PHOTO

When the U.S. Post Office announced that it would begin "aerial mail service," it had no planes and no pilots. The Army Air Service got the dubious honor and mobilized six long-distance Curtiss JN-4s.

Several thousand people, including President Woodrow Wilson, had already gathered at Washington D.C.'s Potomac Park when the first Jenny finally arrived from the factory. Loaded with mail, the airplane at first refused to start, but then amid fanfare it lifted off.

And the pilot promptly got lost, ran out of fuel and plopped in a Maryland field. Meanwhile, a simultaneous southbound run went smoothly, and the New York sacks arrived in Washington just 20 minutes late.

Within months the Post Office took over the flying mailman chores with a fleet of Standard JR-1B mailplanes. Later, officials farmed the work out to private contractors—the ancestors of today's airlines.

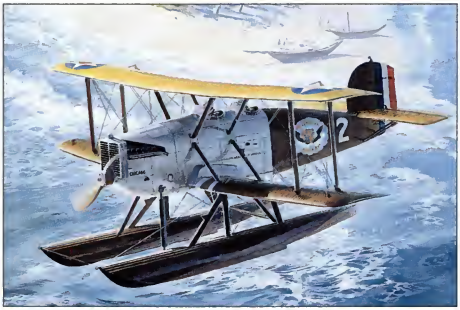
First Round-The-World Aircraft

September 28, 1924

Growing quickly in power and range, the postwar airplanes were shrinking countries and continents. The inevitable began on April 6 when four Army biplanes departed from Sand Point Field in Seattle, bound for the Aleutians, Japan, India, the Middle East, Europe, Iceland, Greenland—57 legs in all—and then home.

The journey quickly turned into an endurance test, as mishap followed mishap. One of the Douglas World Cruisers crashed in Alaska, blindsided by a foggy mountain. The three remaining aircraft fought through exploding pistons and burned-out exhaust pipes as they forged over the tropics.

After hopscotching across Europe, DWCs hit the North Atlantic. Mechanical failure brought down a second plane on its way to Iceland. In neither crash was an airman killed.



PM ILLUSTRATION BY KEITH FERRIS

The great moment came 27,000 miles later, after 371 hours of flying time. The stout Liberty-engined biplanes reappeared over Seattle, greeted by a throng of 50,000 and a congratulatory telegram from President Calvin Coolidge. Said one pilot: "We wouldn't do it again for a million dollars—unless we were ordered to."

First Nonstop Solo Trans-Atlantic Flight

May 20, 1927

The takeoff was dicey. Rain had puddled on the runway, slowing acceleration of the silver-gray monoplane that was already weighed down by 450 gallons of fuel. With its Wright Whirlwind screaming, the diminutive airplane—built specially by Ryan Airlines of San Diego in just 60 days—finally lumbered into the sky just before 8 am, May 20, 1927. The crowd, which had chased him down the runway with fire extinguishers, released a collective sigh when the wheels cleared telephone poles by 20 ft.

Once he was airborne and settled on his easterly great-circle course, the young pilot faced his greatest challenges: keeping fuel flowing from the aircraft's various tanks—and staying awake.

All went almost precisely as he had so carefully planned over the previous months. And when the weary 25-year-old American landed his *Spirit Of St. Louis* at Le Bourget Field outside Paris 33½ hours later, Charles Lindbergh had become a hero of a magnitude never known before.

First Flight To 50,000 Ft.

December 7, 1934

PMI PHOTO

The one-eyed Oklahoman was already a legend after around-the-world flights in 1931 and 1933. But Wiley Post was convinced that faster flying beckoned above 30,000 ft.—in an era when planes rarely ventured above 10,000. So Post commissioned B.F. Goodrich Co. to tailor him a pressurized rubber flying suit.

It failed during a static test. The second literally stuck to Post on a hot, humid July afternoon. Extricating the airman destroyed the suit.

But the third suit—pressurized with a tight cloth outer garment and a bolt-on, oxygen-fed helmet—proved the charm. Post, looking like an astronaut, flew his Lockheed Vega *Winnie Mae* into the jetstream.

First Blind Flight

September 24, 1929

Back then the public knew him as a speedster. But Jimmy Doolittle's greatest legacy to aviation came when he flew nowhere and back, seeing nothing.

In 1928, the Army Air Corps released Doolittle to head a civilian project to conquer the problem of flight in poor visibility.

Doolittle assembled his tools: a barometric altimeter designed by Paul Kollsman, a gyro compass from Lawrence Sperry and a second attitude gyro to provide an "artificial horizon." With these, and directional radios, Doolittle determined he'd have all the information he needed.

In a Long Island fog, he climbed into a Continental NY-2 Husky outfitted with the new instruments, pulled a hood over his cockpit—a safety pilot sat in the forward hole—and took off. He flew a prescribed 15-mile course and landed, flying solely on instruments. And one of the darkest menaces to flight had been dispelled.

Dawn Of The Modern Airliner

December 17, 1935

The maiden voyage had none of the cold-sweat drama that had marked the debut of its prototype, the DC-1, whose engines quit several times during its 12-minute flight. No, the DC-3 flew routinely that cool Santa Monica, California, afternoon, offering a taste of the utter reliability that marked this extraordinary aircraft.

Donald Douglas's masterpiece delivered the knockout punch to Boeing's revolutionary Model 247, which had been the first metal monoplane in a canvas-and-twin-wing sky. The DC-3 went on to dominate the air routes.

PM ILLUSTRATIONS BY KEITH FERRIS

BETTMANN ARCHIVE PHOTO

End Of The Airship Era

May 6, 1937

Many of the airplane's achievements—such as first powered and controlled flight, first airline, first nonstop trans-Atlantic crossing—were in fact first achieved by airships. And while planes and pilots captured headlines in the '30s, airships captured markets. Zeppelins were the true long-distance carriers.

None carried passengers more grandly than the *Hindenburg*. Buoyed by 7 million cu. ft. of hydrogen, the enormous ship could accommodate 75 passengers and 25 crew members.

Disaster struck, however, as the *Hindenburg* completed its 19th Atlantic crossing, its first of 1937. Moments before its mooring at Lakehurst, New Jersey, flames gushed from its rear. Within seconds, the vast envelope had become a torch. The cause of the disaster has never really been explained. But 35 passengers died in the inferno, as did the future of the airship.

First Modern Helicopter

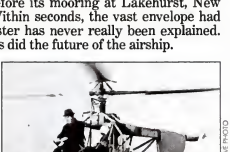
May 13, 1940

His trademark fedora perched firmly on his head, overcoat rippling in the downwash, Igor Sikorsky lifted off the ground at the helm of the VS-300. The contraption would go down in history as the first modern helicopter.

The 50-year-old émigré/engineer/entrepreneur may have been thinking of *The Clipper Of The Clouds*, a Jules Verne novel that his mother had read to him during a childhood illness. Or of the two vertical-flight machines that Sikorsky, not yet 20, had built at his Kiev home.

They didn't fly. Sikorsky suspended his effort, turned his genius to fixed-wing aircraft and succeeded stupendously, building the world's first 4-engine plane. But with the arrival of powerful gasoline engines and his idea that a tail rotor would counteract torque, Sikorsky thought the time was right to try again.

And four years later, Sikorsky was delivering R-4 helicopters to the U.S. Army.



BETTMANN ARCHIVE PHOTO

PM ILLUSTRATION BY JOHN BURKEY

Battle Of Britain

September 15, 1940

On this climactic day, Londoners huddled in tube stations as the city burned anew and the skies snarled with warplanes. And on this day, the BBC reported 185 Reich aircraft shot down. Hitler lost his nerve and two days later abandoned Operation Sea Lion, his invasion plan.

The effort to break the resilient British defenders had failed. It was indeed the RAF's finest hour.

For the plan to have succeeded, after all, it was critical that Germany control the skies. Reichsmarschall Hermann Göring assured the Führer that the Luftwaffe, flushed with victories in Poland, the Low Countries and France, would overwhelm and then eliminate the Royal Air Force in short order.

The attack began in earnest in July as German bombers and fighters raided British ships, ports and fighter bases. RAF Hurricanes and Spitfires rose up to counter the Junkers, Heinkels, Dorniers and Messerschmitts, and what was to become known as the Battle of Britain, history's first pure air battle, was joined.

The battle went on daily and grew in ferocity. On August 15, the Luftwaffe flew more than 2000 sorties and the RAF nearly 1000. Although the combatants were grossly mismatched in number—the Germans began with 3000 warplanes versus the RAF's mere 50 squadrons—radar, a new device, helped maximize the British force, and the RAF pilots, though exhausted, did have home-field advantage.

ALBERT G. SMITH/U.S. NAVAL INSTITUTE PHOTO

First All-Air Naval Battle

June 3, 1942

A month earlier, two navies had flung their aircraft at each other in the Battle of the Coral Sea. But that proved a prelude to a pivotal fight in which the carrier strike force would change the course of naval warfare: the Battle of Midway, June 3 and 4, 1942.

Japan had planned to hammer American forces on Midway Island and then swamp the remaining U.S. naval ships with a 200-ship armada. Fortunately, the Americans had broken the Japanese code and knew the plan. Instead, three U.S. carriers ambushed the Japanese.

Four Japanese flattops and one heavy cruiser fell, along with 234 aircraft and 2500 men. The Americans lost 307 men, 147 aircraft and one carrier. But the battle blunted the Japanese advance and put the American forces on the offensive for the first time.

First Operational Jet Fighter

October 3, 1944

Messerschmitt first lofted its Me 262, powered by twin Junkers Jumo turbojets, on July 18, 1942. Despite its performance—the aircraft eventually reached 540 mph at 20,000 ft.—this hot rod met cold shoulders in high places. And fortunately for the Allies, Hitler ordered that the single-seat fighter be adapted for bombing as well, interference that delayed the Me 262's war service.

Finally, the first jet fighters entered formation under Maj. Walter Nowotny in October 1944, and assembly lines were humming. By 1945, Germany had built more than 1400 Me 262s. Deadly, but too few and too late.

PM ILLUSTRATION BY KEITH FERRIS

PM ILLUSTRATION BY KEITH FERRIS

Breaking The Sound Barrier

October 14, 1947

With two ribs freshly cracked and aching, Capt. Charles "Chuck" Yeager lowered himself through the bomb bay of a B-29 Superfortress. The 25-year-old ace and test pilot maneuvered into the cramped cockpit of the Bell X-1 he christened *Glamorous Glennis* after his wife.

At 26,000 ft., the bomber released the X-1. Yeager flipped switches, igniting his craft's four rocket engines. Upward shot the orange-painted craft at a 45° angle, and 5 minutes thereafter a thunderous sonic boom rocked the desert floor. The X-1 was supersonic.

On October 14, 1947, Chuck Yeager proved that there was life beyond Mach 1. For the record, Yeager reached 700 mph at 42,000 ft., which translates to Mach 1.07.

PM ILLUSTRATION BY BOB WEIR SAATYS

First Successful Jet Airliner

October 26, 1958

When the Paris-bound passengers climbed aboard the Pan Am jet in New York that day, they were inaugurating a new era and coronating a new queen of the skies.

The Boeing 707 had snatched the crown from the Comet, de Haviland's flawed beauty, after authorities grounded that fatigue-prone aircraft following a string of disasters. That same year, 1954, Boeing flew its 367-80, the 707's prototype. The Dash-80 "flew like a bird, only faster," according to cowboy-booted test pilot Alvin M. "Tex" Johnston.

Boeing had gambled $16 million—a quarter of its net worth—on this, its 707th design. Some bet. A total of nearly 1000 civilian and military 707s were built before Boeing finally ceased production of the elegant airliner two decades later.

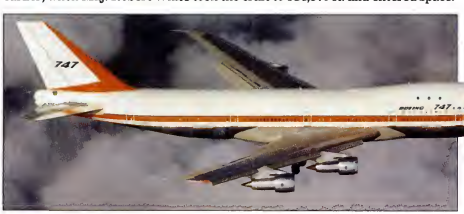
Fastest Aircraft Ever

October 3, 1967

What happened that day, when the X-15A-2 seared across the sky at Mach 6.72—4534 mph? Temperatures of 3000° F barbecued its chrome-nickel skin. A scramjet model mounted on the aircraft's lower fin burned away, leaving a gaping hole that drew heat into the plane's underbelly. Had pilot Pete Knight not already throttled his engines dry, the X-15 would have been blowtorched from the inside out a few seconds later.

North American Aviation had built the 50-ft. rocket plane and its two twins to fly as fast as possible. But, the X-15's biggest contribution came five years earlier, when Maj. Robert White took the craft to 314,570 ft. and entered space.

PM ILLUSTRATION BY KEITH FERRIS



BOEING AIRCRAFT PHOTO

Birth Of The Jumbo Jet

February 9, 1969

This time, no prototype flew. Instead, the first Boeing 747 off the production line roared into Seattle's clouds on February 9, 1969.

Boeing engineers had considered the Air Force's C-141 Starlifter flawed—the cargo hauler was usually full before the machine hit its maximum takeoff weight. So the engineers came up with a super heavyweight carrier with a cavernous cargo hold and asked the service if it was interested. It was. But to make such a purchase up and up, the Air Force put the idea up for bid—and Lockheed won the C-5A contract.

Though disappointed, Boeing agreed to Pan Am's request to adapt its design as an airliner. And on January 22, 1970, aviation and mass transit became one, when *Clipper Young America*, the first 747 airliner, pulled away from the gate at Kennedy International bound for London's Heathrow. There were 336 passengers and 15 tons of cargo aboard.

Unfortunately, one of the four Pratt & Whitney JT9Ds conked out, and the passengers had to transfer to a backup 747 that finally departed 7 hours later. Some might consider that a fitting omen for the jumbo age, when commercial aviation abandoned elitism in the pursuit of high volume.

ANTHONY LEE & CHUCK FINCH/PHOTO RESEARCH

First Supersonic Passenger Flight

January 21, 1976

It was with understandable excitement that on November 29, 1962, officers of British Aircraft Corp. and France's Sud Aviation signed an agreement to join forces and produce the fastest airliner ever conceived. And it was with understandable excitement that passengers boarded the Concorde in Paris and London for simultaneous maiden flights in 1976.

Although the Anglo-French alliance produced a superb Mach-2.2 aircraft, other considerations compromised its success. The major air carriers complained that the cabin and cargo holds were too small, the engines too thirsty and the sonic boom unacceptable over populated areas. Moreover, they said, at three times the price of a 747, the airplane was too expensive.

It all proved too much to counter. In 1979, having won not a single customer beyond their own national carriers, Britain and France agreed to cap Concorde production at 16 planes.

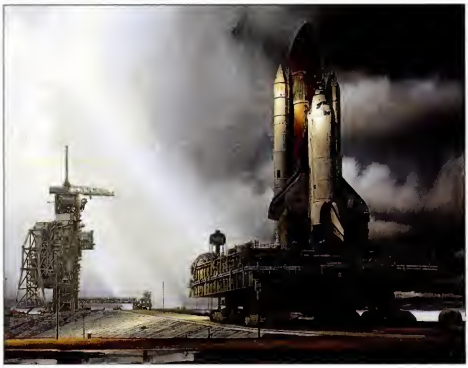
Space Shuttle Flies

April 12, 1981

Twenty years to the day since Yuri Gargarin became the first human in space, Cape Canaveral shook to a new tremor. Six million pounds of rocket thrust hammered Pad 39A at Kennedy Space Center—man was returning to the endless void.

This time, however, the visitors speared into space in a suspiciously familiar vessel, one with a pointed nose, an arrow-like tail, and two unmistakable wings. This was no ballistic capsule that simply plopped back to earth. No. This machine was designed to fly.

And so with the launch of *Columbia*, the art of flying truly merged with the exploration of space. Rockets would thrust the human explorers into the unknown, but they would return to Mother Earth on wings.



PM ILLUSTRATION BY ATTILA PEJACSI

BETTMANN ARCHIVE PHOTO

Nonstop Round-The-World

December 23, 1986

On December 14, Dick Rutan and Jeana Yeager squeezed themselves into the tiny fuselage of one of the oddest airplanes ever constructed. Made of composite materials, *Voyager* was a flying gas tank—its 7011 pounds of fuel was more than three times the weight of the airplane.

When it began its takeoff roll, the fuel-laden wings scraped along the runway for 2 miles before the machine had generated enough speed to actually lift off. But fly it did. And on December 23—nine days, 3 minutes and 44 seconds later, *Voyager* alighted at Edwards again, its two weary voyagers now world travelers and a total of 18 gallons of avgas left in its tanks.

PM ILLUSTRATION BY JOHN BERRY

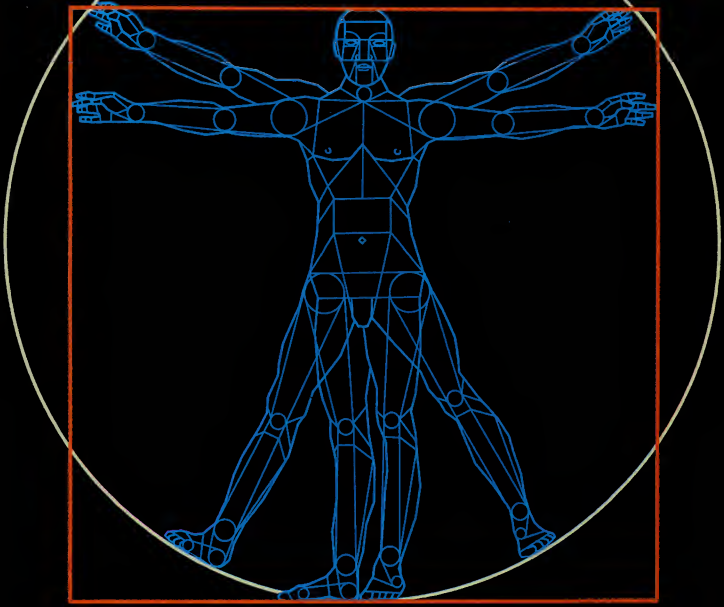
Most Advanced Combat Jet

December 17, 1993

Once again, Seattle is the scene of an aviation first. At a Boeing facility, a computer-controlled milling machine is grinding away at a 4-ft.-long titanium panel. Just another holiday-season Friday afternoon at the machine shop, except that the machine is fashioning the first piece of Aircraft 4001—the nation's first F-22.

When this new fighter rolls out in early 1996, for the first time stealth, agility and speed will be rolled into a single plane. PM

PHYSICAL ENGINEERING



Endowing the physically challenged with a wealth of new capabilities.

BY DAVID FREEMAN

● A few years ago, it would have been unthinkable for disabled athletes to compete successfully in skiing, triathlons and many conventional sports. Not any more. Recent engineering advances are putting the physically challenged into the most physically challenging endeavors.

Take, for example, the shock-absorbing mono-ski, on which an athlete with leg disabilities can slice down slopes at competitive speeds. Called the Shadow Mono-Ski, it is durable enough to handle the stress of competitive skiing. The hydraulic shock is adjustable so that it can provide flexibility or stiffness for beginner, intermediate and expert skiers.

Another breakthrough enabled one athlete with a leg disability to compete in the grueling 1992 Hawaiian Ironman Triathlon. Not only did he complete the running, swimming and bicycling challenge, but his time was an incredible 10 hours, 42 minutes. The key to his

PM ILLUSTRATION BY RON CARBONI

success: a carbon-fiber prosthesis, developed by Flex-Foot, of Laguna Hills, California, that flexes to store energy and then springs back to its normal shape, returning about 95% of the energy to the wearer.

But as inspiring as the sports developments are, they're just the leading edge of an emerging wave of breakthroughs, as engineers are turning their talents to rendering disabilities far less debilitating. The developments range from here-and-now technologies to apparent miracles in the not-so-distant future—devices that may restore walking and lend sight to the blind and hearing to the deaf.

In the here-and-now vein, for instance, engineers are tackling two problems faced every day by wheelchair users. One is the switch from the sidewalks to the freeways. The solution: the rear-entry minivan conversion system, of which a typical example is Kneelkar, made by Mednet, of Battle Creek, Michigan. This mechanism enables a physically challenged driver to use a remote-control unit to open the rear gate, unfold a ramp and move into the minivan as it kneels to just 5 in. above the ground.

Adjustable shock accommodates disabled skiers of all levels.

Meanwhile, for the physically challenged who want a challenging ride, the Quickie P200 promises to be the Ferrari of wheelchairs. Made by Sunrise Medical, of Fresno, California—although at press time not yet sanctioned by the Food and Drug Administration—the Quickie P200 has 25% more power than conventional wheelchairs for improved hill climbing and a shorter wheelbase for nimbler handling.

MEDNET PHOTO

Van conversion lets driver open gate, drop ramp and hydraulically lower suspension.

Rise again

Yet as practical as such developments may seem, they pale before the promise of technologies that may one day make wheelchairs obsolete.

Of these so-called assistive technologies, none sparks more hope than functional neuromuscular stimulation (FNS). The idea behind FNS, which uses electricity to activate muscle cells rendered dormant by spinal-cord injury, dates back to the 1700s and Alessandro Volta, who noticed that muscles twitched upon the application of current.

Today, labs and rehabilitation centers are testing FNS systems for standing and walking, although none has yet obtained final FDA approval. The heart of a typical FNS walking system is a control unit/electrical stimulator. Powered by batteries and typically carried in the user's pocket, this unit delivers current to paralyzed leg muscles through electrodes mounted on or inserted through the skin of the thighs. The user controls the pace and rhythm of the stimulation with finger switches on the handles of a walker.

Despite the promise FNS holds for an estimated 150,000 paraplegics and quadriplegics in the United States, present systems require weeks or months of familiarization. Even then, they are extremely tiring to use, requiring so much more energy than a wheelchair that most patients eventually give up.

To relieve fatigue, researchers are working with FNS units that use as many as 48 electrodes rather than the two to six commonly employed. Also under investigation are fully implantable systems and hybrids that combine electrical stimulation with leg braces called orthoses. One hybrid system, developed at the Massachusetts Institute of Technology, incorporates brakes.

Second sight

In a world designed for the sighted, persons with visual impairments are at a disadvantage. Fortunately, this problem may be rarer in the future, thanks to new systems that use virtual-reality (VR) technology.

One potential application of VR is a personal guidance system to help blind people get where they want to go quickly and safely. As proposed by Jack M. Loomis of the University of California at Santa Barbara, this portable system would link a GPS (Global Positioning System) receiver with a database containing street names, addresses, geographic landmarks and other data. Equipped with headphones and a microphone, a user would simply utter the desired destination, and the system would respond with precise spoken directions.

What makes Loomis's system ingenious is its virtual acoustic display. The technology, now developing at NASA and Air Force labs, transforms monaural sounds into binaural sounds that seem to emanate from specific points in space. This allows buildings and other landmarks to call out to the wearer as he or she walks by, or the desired destination to beckon until the wearer reaches it. A

Quickie P200 offers speed and handling.

SUNRISE MEDICAL/QUICKIE PHOTO

WALTER DOMAIN/EARGLE ASSOCIATES PHOTO

Miniature cameras in this headset give virtual-reality-like viewing to persons with low visual acuity.

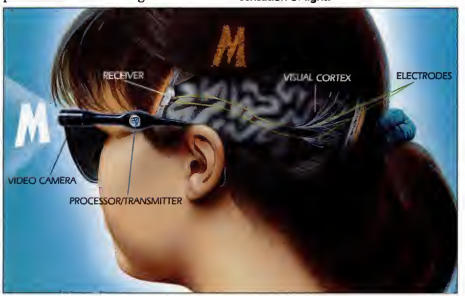
commercial version of this device, predicts Loomis, is 10 years off.

Another NASA spinoff is an electronic viewing device to help persons suffering from low visual acuity that is uncorrectable via eyeglasses, medication or surgery. The brainchild of Robert Massof, a professor of ophthalmology at the Wilmer Eye Institute in Baltimore, the device consists of a headset housing two miniature video screens (one for each eye) and three tiny video cameras. Two cameras provide normal binocular vision. The third eye brings variable focus and magnification into the picture.

But even more radical measures are coming. Neuroscientists have long known that electrical stimulation of the brain's cortex produces sensations of light (phosphenes) in both blind and sighted individuals. Now, researchers are exploiting this phenomenon to create a visual prosthesis capable of restoring a modicum of sight to individuals who are totally blind.

As presently envisioned, a visual prosthesis would consist of a miniature TV camera, an array of microelectrodes implanted in the brain, and an electronic control unit that processes the video signal and then transmits it via radio frequency to the implanted electrodes.

Virtual-reality technology mated to a GPS receiver are the keys to a future guidance system for the blind (above). Aural technology makes sounds emanate from particular points in space (inset). Another device (below) uses data from a camera to stimulate microelectrodes implanted in the brain, producing the sensation of light.



"The sense of sight created by such a prosthesis would be of extremely low resolution, sort of like a grid of lights on a stadium scoreboard," says F. Terry Hambrecht, a researcher at the National Institutes of Neurological Disease and Stroke. The idea, according to Hambrecht, isn't to recreate normal vision, but to enable blind people to at least read printed materials. A practical version of this device is at least five years in the future.

For sufferers of profound (nerve) deafness, technological help arrived in the mid-1980s with FDA approval of cochlear implants, which transmit sound from an external microphone to a set of tiny electrodes surgically implanted in the cochlea. Today, roughly 5000 people have cochlear implants, and current research is fast boosting sound quality. Such a development, once as unthinkable as the disabled triathlete, merely offers a preview of the changes technology can bring to the lives of the disabled. PM

PM ILLUSTRATIONS BY JEFF MANGIAT

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FLAT VISION

This new TV is only 4 in. deep.

BY STEPHEN A. BOOTH, Contributing Editor

● Notch another hole in the belt for the TV industry's ongoing effort to flatten the curvature of its screens. The latest advance in the Battle of the Bulge comes courtesy of Matsushita Electronics, corporate parent of the Panasonic and Quasar brands.

The company's new Flat Vision television, a 13-in.-diagonal model now selling in Japan, is perfectly flat. Amazingly, it's just 3.9 in. thick. More amazing still, the model TH-14F1 isn't a liquid-crystal display (LCD) set, as you might expect from its thinness. It's a glass-vacuum cathode-ray tube (CRT)—actually, about 10,000 of them assembled in a quilt-like pattern.

Don't look for the telltale cone of an electron gun protruding from the rear of the set. Flat Vision doesn't use one. Instead of driving a gun to trace a beam across the breadth of a screen, Matsushita employs a technology called Matrix Drive. In essence, a great number of individual beams are used to ignite small cells of color phosphors. These cells, each really a self-contained CRT, are assembled in a rectangular matrix to form the screen.

Matrix Drive has been in the works at Matsushita for more than a score of years. The premier demonstration came in 1985 at Japan's Tsukuba Science Expo. By the spring of 1989, coinciding with the 50th anniversary of commercial broadcast TV, the company showed 6-in.-diagonal working models just 2.5 in. thick. A 16-in. prototype was only slightly thicker.

Matsushita contended then and affirms now that large screen sizes are possible with Matrix Drive—including widescreen 16:9 formats and high-definition models. Today, 20-in. and 25-in. Flat Vision sets are in the works.

The challenge

Flat Vision is a video hybrid. It adapts technology from both conventional CRTs and active-matrix LCD monitors, and combines the respective advantages of each: The greater brightness of the tube and the wider viewing angle of the flat LCD.

The faceplates of conventional TV tubes are curved for several reasons including sheer physical stamina—a convex surface withstands the stress of a vacuum better than a flat surface. Geometry plays a role, too.

CRTs use an electron gun to pivot a beam from left to right and top to bottom on the screen's faceplate. There the beam strikes the red, green and blue phosphors that produce the color picture. The bigger the screen, the greater the sweep—and, therefore, the deeper the tube must be in order to prevent distortion at the extreme edges.

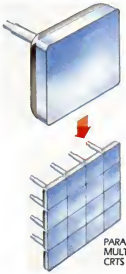
The magnetic lenses in today's guns focus their beams at wider angles more accurately than before to hit the correct phosphors. And the metal shadow-mask that sights the targets is less prone to the heat-warpage that might alter the beam's path. Additionally, a latticework of opaque-black pigment separates each color phosphor, further reducing the chance that a misguided beam will light the wrong one. Still, there are limits.

CRTs need depth and some curvature to deliver a bright, accurate image. Unfortunately, curved surfaces tend to reflect ambient light, and the resulting glare washes out the display by reducing its contrast. Also, you can't see around a curve: Viewers seated at extreme angles won't get the whole picture.

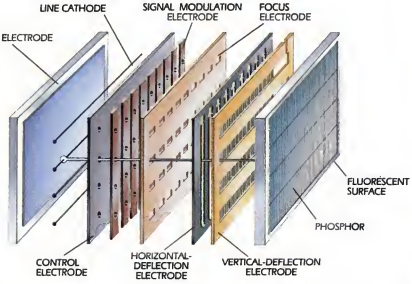
Thin, ruler-flat LCD televisions overcome the geometry problem by eliminating electron beams entirely. A so-called active matrix of individual electrodes supplies voltage to each specific pixel of the red, green and blue phosphors.

The downside of LCDs, at this

IMAGE OF FLAT VISION



BASIC STRUCTURE OF FLAT VISION



PM ILLUSTRATIONS BY ADOLPH E. BROTMAN

writing, is cost and brightness. Large LCD panels—even 13-in. ones—are hard to manufacture and, therefore, prohibitively expensive. Meanwhile, picture brightness, relative to screen size, remains low compared to CRTs.

How it works

Matsushita's Matrix Drive gets the flatness of LCD with the brightness of CRT by making the latter extremely small—measuring less than ⅕ in. high × 1/20 in. wide. Picture these dimensions and you'll understand how the glass "tube" can be made flat. All told, the 13-in. Flat Vision TV contains 9680 of these tiny CRTs. The screens have just two rows of five RGB pixels—each pixel is a trio of red, green and blue phosphors.

Because they're so small, Matsushita can create an electrode grid to drive each mini-CRT in sequence, in a manner similar to the active matrix of an LCD panel. Instead of a single (3-beam RGB) electron gun, Flat Vision has a grid of 44 line cathodes running horizontally across the screen. These intersect 222 vertical control electrodes standing left to right across the screen. The intersection points—9768 of them—become the control centers for each tiny screen.

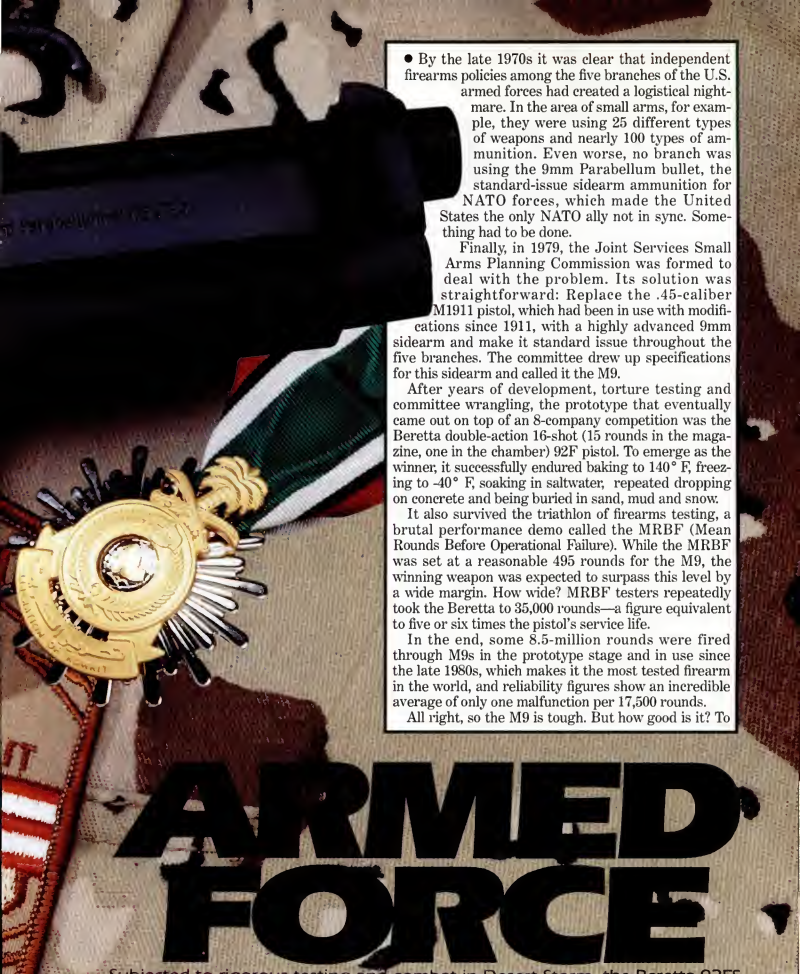
Under the hood, or behind the faceplate as illustrated on the opposite page, the action's a bit more complicated than the pull-and-fire skeet shoot of a typical CRT's electron gun.

The sheet-like linear cathodes—all 44 of them equivalent to a tube's cathode—produce electron beams through the interaction of the rear and the control electrode plate. These beams then pass between the signal-modulating electrode and the focus electrode before the horizontal- and vertical-deflection electrodes dispatch them to the appropriate phosphors on the fluorescent screen.

Sounds simple, but what's missing?

(Please turn to page 92)

PISTOL
DESERT STORM



ARMED FORCE

Subjected to rigorous testing and combat in Desert Storm, the Beretta 92FS passes muster as the official U.S. military sidearm.

BY ALEX ZIDOCK; PM Photos by Brian Kosoff

● By the late 1970s it was clear that independent firearms policies among the five branches of the U.S. armed forces had created a logistical nightmare. In the area of small arms, for example, they were using 25 different types of weapons and nearly 100 types of ammunition. Even worse, no branch was using the 9mm Parabellum bullet, the standard-issue sidearm ammunition for NATO forces, which made the United States the only NATO ally not in sync. Something had to be done.

Finally, in 1979, the Joint Services Small Arms Planning Commission was formed to deal with the problem. Its solution was straightforward: Replace the .45-caliber M1911 pistol, which had been in use with modifications since 1911, with a highly advanced 9mm sidearm and make it standard issue throughout the five branches. The committee drew up specifications for this sidearm and called it the M9.

After years of development, torture testing and committee wrangling, the prototype that eventually came out on top of an 8-company competition was the Beretta double-action 16-shot (15 rounds in the magazine, one in the chamber) 92F pistol. To emerge as the winner, it successfully endured baking to 140° F, freezing to -40° F, soaking in saltwater, repeated dropping on concrete and being buried in sand, mud and snow.

It also survived the triathlon of firearms testing, a brutal performance demo called the MRBF (Mean Rounds Before Operational Failure). While the MRBF was set at a reasonable 495 rounds for the M9, the winning weapon was expected to surpass this level by a wide margin. How wide? MRBF testers repeatedly took the Beretta to 35,000 rounds—a figure equivalent to five or six times the pistol's service life.

In the end, some 8.5-million rounds were fired through M9s in the prototype stage and in use since the late 1980s, which makes it the most tested firearm in the world, and reliability figures show an incredible average of only one malfunction per 17,500 rounds.

All right, so the M9 is tough. But how good is it? To

.40 CALIBER BERETTA 96 CENTURION

find out, I went to Beretta U.S.A.'s manufacturing plant in Accokeek, Maryland, south of Washington, D.C., to see how it's made. Then, I spent some quality time with it at the shooting range.

Beretta calls the most recent version of the M9 the 92FS. It weighs 40.89 ounces with 15 rounds in the magazine (34 ounces empty), and it feels nimble and well balanced in the hand. Specifications are 8.54 in. from the tip of the nickel-chromemoly steel barrel to the back of the grip, and 5.51 in. from the bottom of the grip to the top of the slide, which is also made of nickel-chromemoly steel. Its surprising lightness comes from the 7075-T6 aircraft aluminum in the frame.

Fast target acquisition is a top priority, and the M9's sights are state of the art. The front sight has a large white dot below the top of the blade that stands out in sharp contrast to the flat-black finish of the slide. The rear sight is a notched square with either a white post below the notch or two large dots on either side.

The open slide is another important user feature because it offers the shooter direct access to the chamber, even when the slide is all the way in the rearward position. If there's a malfunction or a jam, the shooter can easily flip over and dump or clear ammunition from the enlarged ejection port.

Double-action, a unique decocking device and the firing-pin locking block enable the Beretta to be confidently carried with a round in the chamber and still be ready to shoot. To accomplish this, the shooter deploys a decocking device that rotates the firing pin out of position and drops the hammer even though a round is chambered. The possibility of accidental discharge is eliminated, and the weapon can still be fired by simply pulling the trigger.

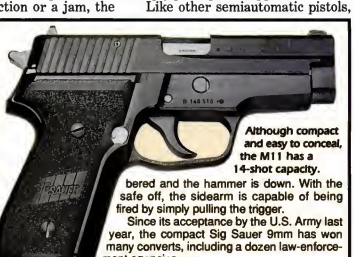
Like other semiautomatic pistols,

The M11 Compact Pistol

● After the five branches of the U.S. military began putting Beretta-made M9s into service, the U.S. Army Military Police School at Fort McClellan, Alabama, drafted a plan to add a compact 9mm sidearm to the list of authorized weapons. Requirements called for the M11 to be a 9mm semiautomatic double-action pistol holding a minimum of eight rounds. It had to have an overall length of 7.8 in., feature an ambidextrous magazine catch and have a reliability rate of 17 allowable stoppages out of 15,000 rounds fired.

The winner of the ensuing bid-and-torture-test process was the Sig Sauer 228 or, as the Army calls it, the M11 compact pistol. The new M11 is intended to be used by military police, flight crews, armor crews, intelligence agents, general officers and other approved personnel who may prefer it to the full-size M9.

Overall size of the Sig Sauer 228/M11 is 7.8 in. long and 5.35 in. high. It has an unloaded weight of 29.1 ounces and an ammunition capacity of 14 rounds (13 in the magazine, plus one in the chamber). Like the M9, the M11 has a decocking lever that deactivates the firing pin when a bullet is chambered and the hammer is down. With the safe off, the sidearm is capable of being fired by simply pulling the trigger.



Although compact and easy to conceal, the M11 has a 14-shot capacity.

Since its acceptance by the U.S. Army last year, the compact Sig Sauer 9mm has won many converts, including a dozen law-enforcement agencies.

For information on civilian models, write Sigarms, Industrial Dr., Exeter, NH 03833. —A.Z.

Inside The Beretta 92FS

FIRING-PIN BLOCK
FIRING PIN
HAMMER
SLIDE-RAIL SLOT
HAMMER PIN
RECOIL SPRING GUIDE
RECOIL SPRING
LOCKING BLOCK
SEAT
DISASSEMBLY LATCH
TRIGGER
HAMMER STRUT
TRIGGER GUARD
BARREL
REVERSIBLE MAGAZINE RELEASE BUTTON
HAMMER SPRING
FOLLOWER
HAMMER-SPRING CAP
MAGAZINE SPRING
LANYARD LOOP
FRAME
15-ROUND STAGGERED MAGAZINE
9MM HOLLOW POINTS
GRIP

A recent improvement in the 92FS is the slide-rail slot beneath the barrel (top). The barrel and slide (left) are made of nickel-chromemoly steel, while the frame is made of aluminum. The red warning dot on the exposed extractor (above) is a visual display indicating a loaded chamber.

the 92FS has a safety beneath the rear sight that utilizes a firing-pin blocking bar. However, unlike the others, the Beretta's blocking bar protrudes through the slide, indicating that the safety is in working order. Another unique feature is a loaded-chamber indicator, which uses a red warning dot on the exposed edge of the raised extractor to tell the shooter that a round is in the chamber.

As mentioned, the original designation of this Beretta sidearm was changed from 92F to 92FS. The S stands for slide over-travel system, and it consists of a slot cut under the left slide rail and a hammer pin with an oversize head. This beefed-up system ensures that the slide will remain intact even if the sidearm is abused through repeated firing of high-pressure loads.

Other important features on the 92FS are a straightened and grooved trigger guard for a good 2-handed grip, a barrel with chrome plating and a coating of an epoxy resin and a lanyard ring on the bottom of the grip.

The torture testing I mentioned earlier is only part of the story. The final set of tests begins with the firing of an extremely high-pressure proof round. After examination for damage or cracks, the pistol is then locked in a bench rest and tested for accuracy at 50 meters.

Out of 6000 sidearms that pass the tests, 30 randomly selected pistols are fired with a soft copper-backed dummy cartridge to test firing-pin depth and concentricity. Ten of these pistols are completely disassembled, and the parts are mixed before reassembly. Then they are tested and analyzed again. For a final kicker, a group of three are subjected to 15,000 rounds of firing.

To be sure, these are rugged tests, but the weapons serve a rugged purpose. The 92FS has already proven itself in combat in the Gulf War, Somalia, Panama and Grenada. Several 9mm and .40-caliber models have been put into civilian service by more than 800 law-enforcement agencies throughout the country. **PM**

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● As we get ready to welcome some '94 newcomers into the PM long-term test fleet, we find ourselves saying farewell to several faithful veterans.

Cadillac Eldorado Touring Coupe

Editor's Note—In a previous report, we stated that the 7500-mile service at Brogan Cadillac in Ridgewood, New Jersey, cost $337.03. This was incorrect. Our bill did total $337.03. However, the total included $260 to repair damage to the front fascia incurred in a snowstorm. The actual cost of the 7500-mile service was $77.03 for parts and labor. Also, we misspelled the name of Brogan Cadillac. We regret the errors.

This is the fourth and final report on our long-term test of Cadillac's Northstar Powertrain System, which was wrapped in the guise of an Eldorado Touring Coupe. We wanted to know if such a sophisticated, complex system could be reliable in daily hard use. A 32-valve dohc sequential port fuel-injected V8 pumping out 295 horsepower is not your everyday auto engine. Nor is the 4-speed totally computer-controlled automatic your garden-variety transmission. So we wanted to know.

Now we know.

Cadillac's Northstar Powertrain System is a gem. In the past 12 months and 20,000 miles, we have de-

TOYOTA COROLLA LE

PM PHOTOS BY ROY ATTAWAY

DODGE INTREPID ES

PM PHOTO BY RICK ATTAWAY

JEEP GRAND CHEROKEE LAREDO

PM PHOTO BY RICK ATTAWAY

liberately *beat* on this engine. We drove it extra hard. Floored the throttle whenever possible. Put extra demands on the powertrain whenever we could. The car made 1000-mile trips and 42-mile daily commutes. It rolled at 90 mph on interstates and sat in 105° heat in gridlocked New York City traffic. Yes, we purposely tried to break it.

We couldn't. The car is still as strong and reliable as the day we picked it up. The Northstar is one world-class engine that will give any owner years of pleasurable driving. We're sorry to let this one go. —*Joe Oldham*

Toyota Corolla LE

N.Y.C. parking can be a nightmare. It can also mar the service record of even the most reliable of cars. If you park on the street, you risk having it stripped, hit, ticketed or towed. And even an attended parking garage is no guarantee against disaster.

Take our Toyota Corolla, for example. It was serving us just fine, racking up 100 miles a day at 29 mpg commuting in and out of the city, as reliable as sunrise. Then we noticed a major-league mystery dent. The garage attendants just shrugged and we got stuck with a $1590 bodyshop bill, plus two weeks without our precious Corolla. Then, as the car sat waiting to be picked up, some kids threw a baseball through the windshield. Three more days were lost.

At least the Toyota dealership, where we had our 15,000-mile service, was prompt. We dropped off the car at 10 am and picked it up that afternoon. In a way, the simplicity and efficiency of the whole system was worth the $428.63 service bill.

With more than 23,000 miles on the odo, it's time to say goodbye. And, although we found the seats a bit too firm and the lack of a glovebox light frustrating, we can cite no other fault—the Corolla served us well. The power, reliability and roominess of this compact make it one of the best in its class.

—*Deborah Frank*

MERCURY VILLAGER LS

PM PHOTO BY G PHOTO

Dodge Intrepid ES

We've racked up more than 5000 miles on our Intrepid since our last installment. Almost without exception, they've been trouble-free and remarkably pleasant. Passengers who haven't had a ride in a Chrysler LH sedan are invariably amazed at the spacious interior as well as the capacity of the trunk.

Driving the Intrepid is not exactly sports-car-like, but very nearly so, as the suspension and steering are firm and well controlled. There's no wallow and virtually no sway, and the suspension seems to swallow up New York City's numerous potholes.

We're achieving an amazing 18 mpg in 2-ft.-at-a-time grudge-match commuting. Highway driving sees 27 to 28 mpg displayed on the trip computer. Such mpg is nothing short of miraculous for a 214-hp 4-cam 24-valve V6 towing a 3300-pound sedan.

The single complaint was a minor but annoying wind leak in the left rear window. Sure enough, we soon saw a Technical Service Bulletin addressing the problem. And the dealer corrected it at the first service.

We're planning to keep this one around as long as we can.

—*Mike Allen*

SUBARU IMPREZA SPORT WAGON

PM PHOTO BY DAVID DEWHURST

In fact, it was so popular that two PM staffers went out and bought their own after driving our test car.

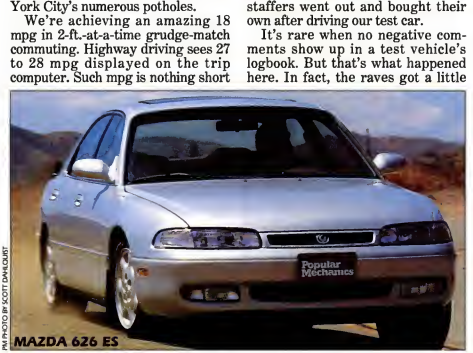
It's rare when no negative comments show up in a test vehicle's logbook. But that's what happened here. In fact, the raves got a little boring to read after awhile.

If you read our last report, you know we didn't like the stock tires and that our Jeep suffered from some vandalism. But none of that is the fault of the vehicle. What you can say about the Jeep Grand Cherokee is that it is one very livable vehicle that is also very lovable—to everyone who drives it and everyone who sees it.

It's immensely versatile, equally at home in front of a Home Depot, a Little League field or Tavern On The Green. It's equally adept at hauling people, a boat or just yourself. Whatever task it's assigned, it does with aplomb. And with style. It's easy to drive, easy to live with and seemingly bulletproof. All we did for a year was perform by-the-book maintenance and keep it full of gas.

One last thought. If you buy one—get the optional V8. It really makes this vehicle.

—*J.O.*



MAZDA 626 ES

PM PHOTO BY SCOTT DAHLQUIST

Jeep Grand Cherokee Laredo

This has to rank as one of our all-time-favorite long-term test vehicles.

Mercury Villager LS

After 18,000 miles, our Mercury Villager drives like it just rolled out of the showroom. We've appreciated its carlike handling and performance, as well as its removable seats that convert the interior to a big cargo hauler.

The engine fired up smoothly on the very first crank, and hasn't missed a beat since, complemented by a tight, solid feel to the body and the absence of creaks and vibrations. Fuel economy has been a steady 21.3 mpg.

Villager's interior ranks as one of the most convenient in the industry, with pockets in the doors, storage bins, cup holders and nooks in the instrument panel. The flat floor and reach-through space between the seats hold all kinds of items within easy range of the driver.

How does Villager stack up against the industry-leading Chrysler minivans? Villager is about the same size as the standard Chrysler, though there's no extended body option. Drivetrain performance is at least on a par with the Chryslers, even without an awd option. And interior layout and conveniences are at least equal. Call it an alternative worth examining.

—*Jim Dunne*

(Please turn to page 112)

GMC SUBURBAN SLE

PM PHOTO BY RW THURBY

PERSONAL COMMUNICATORS

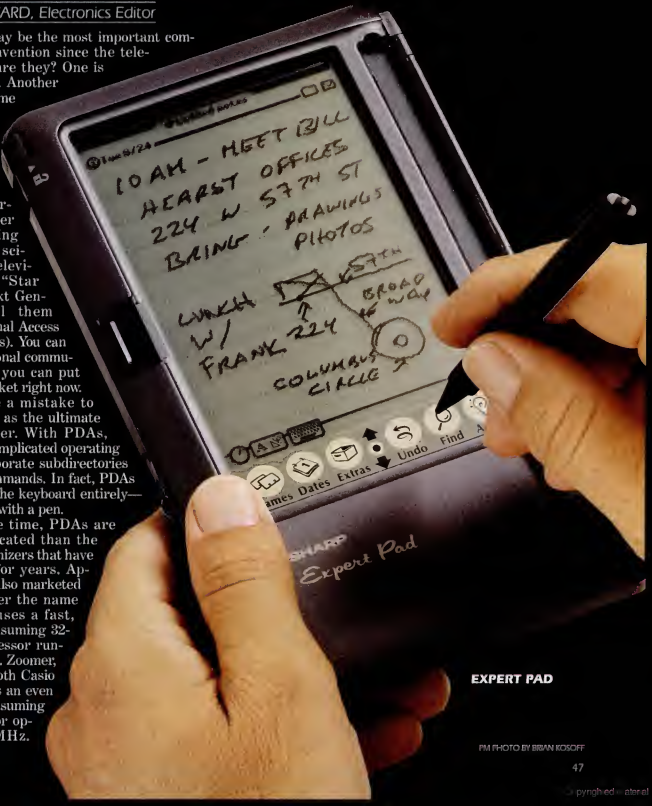
A new breed of pen-based computers work like your brain and fit in your pocket.

BY FRANK VIZARD, Electronics Editor

● They just may be the most important communications invention since the telephone. What are they? One is called Newton. Another goes by the name Zoomer. The industry calls them Personal Digital Assistants (PDAs). The Klingons, Ferenghi and other races inhabiting the futuristic science-fiction television series, "Star Trek, The Next Generation," call them PADDs (Personal Access Display Devices). You can call them personal communicators. And you can put one in your pocket right now.

It would be a mistake to think of PDAs as the ultimate small computer. With PDAs, there are no complicated operating platforms, elaborate subdirectories and arcane commands. In fact, PDAs dispense with the keyboard entirely—you enter data with a pen.

At the same time, PDAs are more sophisticated than the electronic organizers that have been around for years. Apple's Newton, also marketed by Sharp under the name Expert Pad, uses a fast, low-energy-consuming 32-bit RISC processor running at 20 MHz. Zoomer, marketed by both Casio and Tandy, uses an even less energy-consuming 16-bit processor operating at 7 MHz.



EXPERT PAD

PM PHOTO BY BRIAN KOSOFF

Copyrighted material

The biggest difference, though, lies in the PDAs' communications capabilities and the variety of software with which they can be used.

The standard bearer for PDAs is Apple's Newton. What you grab right away, both physically and intellectually, is the pen. With the pen you can print, write in cursive or draw pictures and diagrams. Newton will then clean up your scrawls and turn them into typed notes and legible graphics. Text, graphics and handwritten notes can even be combined for simultaneous display. What you're actually seeing on the liquid-crystal display is electronic ink formed when the stylus pushes down the top layer of conductive material onto another conductive layer underneath. The point where the voltage is interrupted appears as an ink mark.

The handwriting-recognition software in Newton is one of the core technologies of the machine. The software uses what are called recognizers to analyze what you have written. These recognizers actually work better with time. As you continue to use Newton, the recognizers adapt to how you write letters and numbers. Newton may not recognize your letter "g" the first time, but it will eventually as it gets to know you better.

Also at the core of Newton is how it handles information. Unlike computers, which require you to open files before entering any data, Newton almost works like your brain in terms of how it processes information. Newton lets you spontaneously store bits of data as independent notes—think of them as separate scraps of paper. These notes go into little folders stored in Newton's memory.

Unlike a computer, Newton has the ability to sort through all of these different folders and retrieve bits of connected data. If you were scheduled to lunch with Barbara Novak, for example, Newton could also retrieve all the information relevant to this person, such as her business address, previously discussed projects and a map to her office. Just like your brain, Newton can make intelligent connections between bits of information.

Newton's built-in capabilities are augmented by a slot for PCMCIA cards. About the size of a credit card, a PCMCIA card is dedicated to a specific task. Optional PCMCIA cards for Newton include topics as diverse as "Fodors '94 Travel Manager" and "STATS," a compendium of baseball statistics.

PCMCIA cards can also increase memory capability. As it is, Newton has 192K of RAM and 4MB of ROM, roughly the equivalent of 600 screens of information.

PCMCIA cards can even let you know where you are. AT&T Microelectronics, Trimble Navigation and other partners are developing cards that use the Global Positioning System (GPS), a satellite navigation system offering pinpoint accuracy in determining location.

PCMCIA cards vary in price, but they typically range from about $30 to $150.

A PCMCIA card also lets Newton receive pages. The Messaging Card is a radio paging receiver that displays messages on screen.

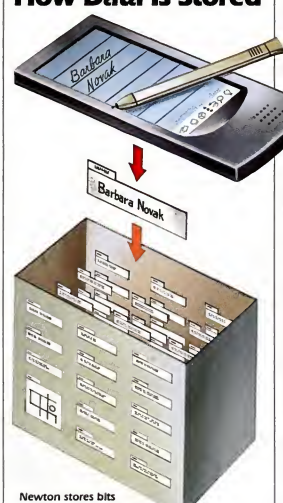
Two Newtons can also exchange information via an infrared link with a 1-meter range. Newton can also download data to a personal computer or printer.

With an optional modem, Newton can expand its communications range. If you want to send a fax, simply write out the message and the command "fax Barbara." Newton automatically formats the fax complete with cover letter, deduces that the recipient is Barbara Novak (if there is more than one Barbara, Newton will let you choose from a short list), retrieves the fax number and sends it at the touch of a button. Newton can also work as an auto-dialer.

Newton Mail, meanwhile, is an on-line service soon to be offered by Apple that links Newtonians with subscribers to the Internet on-line service.

The second standard bearer is Zoomer, sold by Casio and Tandy. Zoomer is similar to Newton in many ways. If anything, Zoomer has more built-in software, in-

How Data Is Stored



Newton stores bits of information in little folders, but can intelligently retrieve all the folders relating to a single subject.

PM ILLUSTRATION BY ADOLPH E. BROTMAN

cluding programs that access the America On-Line Network (a language translator), "Pocket Quicken" (financial software), a variety of reference material and other items. Zoomer also supports PCMCIA cards, giving the machine added capabilities.

Communications capabilities are somewhat similar, as well. Zoomer does not have a built-in fax capability but relies on a PCMCIA card for that job. With the exception of the built-in America On-Line program, in fact, Zoomer relies on PCMCIA cards for most of its communications skills.

Another similarity is the list price —about $800 for Newton and $700 for Zoomer.

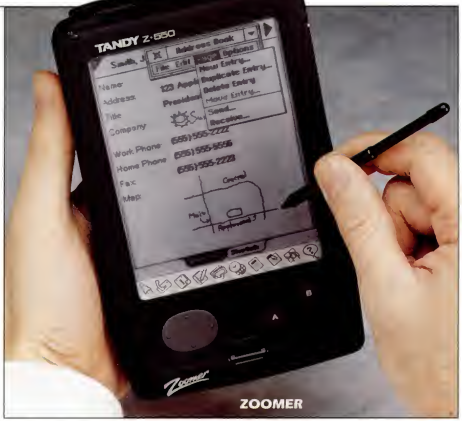
Both products also run on alkaline batteries. Newton uses four AAA batteries that provide about 21 hours of service. Zoomer uses three AA batteries offering more than 50 hours of use.

The major difference between the two, though, involves the handwriting-recognition software. Zoomer only recognizes block printing and not cursive writing, a restriction that tends to slow down the data-input process. Zoomer differs in the amount of memory available, as well—350K of available RAM and 4MB of ROM.

Newton and Zoomer are in many ways derivatives of the much more expensive and larger EO personal communicators marketed by AT&T to business users. EO has a pen-based data-input system and includes a cellular phone for communication. But EO is too large and cellular phone rates are too expensive for casual users.

Likewise, there will be more PDAs derived from the Newton and Zoomer models. Compaq, Motorola and IBM are working on PDAs—the latter's is likely to be a small version of its ThinkPad portable-computer line.

In Europe, meanwhile, Amstrad, a British company, is selling its own PDA with software supplied by



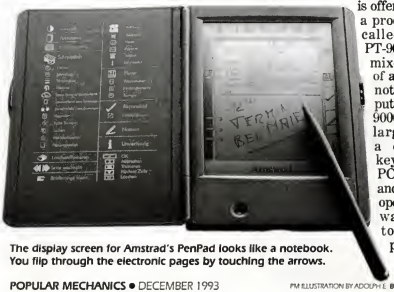
ZOOMER

Texas Instruments. In some respects, the Amstrad PenPad is actually an improvement on Newton and Zoomer. The screen actually looks like a notebook, complete with what appear to be loose-leaf binder rings. To discard information, you simply press one of the rings and pull the "page" off the screen. Functions appear on the screen by touching any of the icons aligned along the top and the right side of the display. You even search for information much like you would in a notebook. Two arrows in the upper righthand corner let you flip through the electronic pages until you find the desired information. This is about as far from a computer operating system as you can get.

In the short term, you can expect other types of products that use either Newton or Zoomer technology. Sharp, for example, is offering a product called the PT-9000, which mixes features of a PDA and a notebook computer. The PT-9000 features a large display, a detachable keyboard, two PCMCIA slots and GeoWorks operating software. Newton's data-processing software, meanwhile, is slated for use in telephones, sketch pads and a variety of business devices.

Farther out on the horizon—but closer than you may think, according to AT&T Micro-electronics—are PDAs with even more stunning capabilities. This vision of a PDA includes a machine with a built-in modem, a cellular phone, speech-recognition software so data input is by voice (you speak, it listens) and a display that would show high-quality still images and full-motion video. The glass display would be replaced by a plastic material that would be lighter, more shock resistant and could even be rolled or folded. And, of course, it would fit in your pocket. That's a lot of technology devoted to staying in touch. PM

A PDA of the near future as envisioned by AT&T Micro-electronics: cellular phone and speech-recognition software are built in and the display shows still images and full-motion video.


The display screen for Amstrad's PenPad looks like a notebook. You flip through the electronic pages by touching the arrows.

PM ILLUSTRATION BY ADOLPH E. BROTMAN

POPULAR MECHANICS IMPORTS'94

BETTER THAN GOOD

With competition tougher across the board, it's clear that being merely good is no longer good enough.

BY TONY SWAN, Automotive Editor

● Although the situation didn't just materialize overnight, we think it bears mention anyway: There aren't any bad cars anymore.

Import or domestic, the pressures of competition have steadily raised the acceptable quality minimums to the point where almost any vehicle can be expected to provide reliable, safe, hassle-free service during its lifetime. If it doesn't measure up to that standard, it can be expected to disappear. A good many have.

While this is pretty much universal today, it's not unfair to say that the imports—particularly the Japanese imports—were a key element in the overall improvement. The quality standards established by manufacturers like Toyota, Honda, Nissan, Mitsubishi, Mazda et al. have forced the worldwide industry to make better vehicles across the board. And even though the quality/durability/reliability picture is more uniform than at any time in recent memory, the Japanese are still setting the pace. Toyota, in particular, dominates the various J.D. Power quality indexes.

With that in mind, here's what's on the immediate import horizon for the 1994 model year. We should also note that the word import is used here to embrace any brand name produced by a manufacturer headquartered somewhere other than the United States.

Acura

The dimensions are similar, and it's pretty much the same base engine. But beyond that, this is an all-new **Integra**, inside and out. Research revealed that previous Integras weren't scoring well on the fun-to-drive index, so that was a key design target for this one. And judging by our first encounters, the design team scored a bull's-eye, particularly with the hot-rod **GS-R** version.

A new **170-hp 1.8-liter dohc 16-valve VTEC Four** lends real urgency to the GS-R's forward progress, and the redesigned chassis makes it very easy to drive quickly. Ride quality and noise isolation are both improved, and so is the interior.

The new Integra's styling makes it clear that fun-

FERRARI 348 CABRIOLET

to-look-at is an important part of fun-to-drive.

Integras will be offered in two body styles—coupe and sedan—with three trim levels for each, including a **GS-R sedan** for the first time. Dual airbags are standard, and antilock brakes are optional.

Elsewhere at Acura, there will be a **GS** version of the **Legend Sedan** for '94, featuring the 230-hp V6, 6-speed manual transmission and sporty suspension introduced in the Legend Coupe last year. The superb **NSX** 2-seater gets bigger alloy wheels and fatter tires.

Alfa Romeo

Alfa's handsome **164** sedan series gets a power infusion for '94 with **two new 16-valve** versions of its **3.0-liter V6** engine family, rated at **210** and **230 hp**. The coming model year will also be the last for Alfa's Spider.

Aston Martin

Aside from dual airbags, A-M's elegant **Virage coupe** and **Virage Volante convertible** enter 1994 unchanged.

Audi

Introduced at midyear, Audi's new Cabriolet is a topless version of the old Coupe Quattro, towed by the same smooth 172-hp 2.8-liter V6 that powers the 100 series.

Beyond the recent addition of a 100S Wagon and minor trim changes to the 90 and V8 Quattro, Audi's 1994 lineup is unaltered.

Bentley

Three basic models—the **Brooklands**, the **softtop Continental R** and the **Continental R coupe**—continue to make up the Bentley line. Upgrades include a long-wheelbase Brooklands variant, **dual airbags** and a **20% horsepower increase** across the board.

BMW

The midyear arrival of the **new Cabriolet** completes BMW's handsome 3-series lineup. The new ragtop is propelled by BMW's potent 2.5-liter dohc 189-hp inline Six. A removable aluminum hardtop is optional.

BMW has also added its **new dohc 32-valve alloy V8 engines** to the 5-series, creating the **530i** (3.0 liters, 215 hp) and the **540i** (4.0 liters, 282 hp), plus a V8 version of the station wagon model, the **530i Touring**.

BMW has also made the 4.0-liter V8 engine available in the 8-series coupe—the **840Ci**.

Ferrari

There's more muscle—**312 hp**—on tap in the **348's 3.4-liter dohc 32-valve V8**, but of perhaps greater interest to Ferraristi is what's gone—the 348's roof, creating Ferrari's first 2-seat spider since the Daytona.

Honda

The **all-new Accord** is reviewed in one of our Drive Reports. But there's another significant newcomer in the stable for '94. It's called the **Passport**, and it's the first **sport/utility** vehicle Honda has ever offered. If the Passport looks strangely familiar, it's because Isuzu offers the same vehicle, and calls it the Rodeo.

At the small end of the spectrum, Honda has raised the **Civic del Sol** into the pocket-rocket class with the availability of a **160-hp 1.6-liter dohc 16-valve VTEC engine**.

Hyundai

Although it's technically a 1995 model, look for a **new Sonata** to roll into Hyundai showrooms in early '94. This will be an all-new car—bigger, riding a longer wheelbase and a more sophisticated suspension.

ACURA INTEGRA

ALFA ROMEO 164

BMW 740i

DRIVE REPORT

HONDA ACCORD

● It takes only a glance to discern the most important change in the new Accord, fifth in Honda's pace-setting midsize series. Not necessarily the biggest change. But definitely the most important.

The fourth-generation Accord, introduced for 1990, drew flak for its conservative styling, barely changed from generation three. And ultimately, it lost its U.S. best-selling-car title to the Ford Taurus.

Honda obviously took this lesson seriously. With its rounded front and raised decklid, the new Accord sports a much more international flavor. Its Accord lineage is readily apparent, but there's also a hint of BMW 3-series. Its wider track (and wider body) lend a more aggressive look, and there's more room inside to go with it.

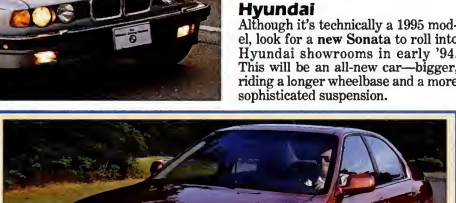
As you'd expect of a Honda, there's a host of functional changes. Chassis rigidity has been upgraded, handling is even more positive and ride quality has improved. The addition of Honda's VTEC variable-valve timing system extracts more power *and* mpg from the upscale EX version of the 2.2-liter Four. And there's a V6 en route a few months down the pike.

Looks like another best seller to us.

—*Tony Swan*

SPECIFICATIONS

Layout	Front-engine, front-drive
Body styles	Sedan, coupe, wagon
Engines	130-hp sohc 16V 2.2-liter I4 145-hp sohc 16V VTEC 2.2-liter I4
Transmissions	5M, 4A
Wheelbase	106.9 in.
Track, f/r	59.6/59.1 in.
Length	184.0 in.
Width	70.1 in.
Height	55.1 in.
Min. curb weight	2800 lb.
Brakes, f/r	Disc/drum; Opt: disc/disc, ABS



MICHAEL BOLAND

BMW 3-SERIES CABRIOLET

Look for more power from the base engine, a 137-**hp dohc 16-valve Four**. The optional powerplant will be Hyundai's 142-hp 3.0-liter sohc V6.

One more thing to expect from this mainstream midsize sedan: one of the lowest base prices in this class, probably well under $13,000.

With the exception of the premium subcompact **Elantra**, which gets a cosmetic update, Hyundai's other 1994 changes are limited to minor trim and color variations.

INFINITI Q45

PHOTO BY BILL HUPMAN (EXPANDED)

DRIVE REPORT

LAND ROVER DEFENDER 90

● This jaunty little rock-hopper will inevitably produce comparisons with Jeep's popular Wrangler. After all, the Wrangler has many of the same off-road capabilities, it's similar in spirit—and its pricing starts at about half the price of a Defender 90.

But to knowledgeable off-roaders, such comparisons will be a little specious. The Wrangler is certainly rugged and tough, but the Defender is in a back-country class of its own. Besides the only V8 available in a softtop sport/utility, the Defender has the same long-travel suspension and 4wd system that distinguish its big brother, the Range Rover.

This is the most supple off-road suspension in the business, enhanced in the Defender by extraordinarily steep approach and departure angles (51° and 52°, respectively).

The 4wd system is full-time, and the 2-speed transfer case features a locking center differential for really tricky going.

All things considered, the Defender is the most capable off-road civilian vehicle this side of the Hummer, and a whole lot more fun to drive, particularly on the street. Yes, it's pricey. But it's also the best of its kind. —*T.S.*

SPECIFICATIONS

Layout	Front-engine, 4wd
Body style	2-door
Engine	182-hp ohv 3.9-liter V8
Transmission	5M
Wheelbase	92.9 in.
Track, f/r	58.5/58.5 in.
Length	160.5 in.
Width	70.5 in.
Height	80.2 in.
Min. curb weight	3560 lb.
Min. ground clearance	9.0 in.
Brakes, f/r	Disc/disc

Infiniti

The biggest news from Nissan's luxury division for '94 is the redesign of the top-of-the-line **Q45** sedan, which got a Jaguaresque grille earlier this year, as well as slightly softer suspension tuning and interior trim revisions.

Isuzu

Having limited itself to trucks and sport/utility vehicles, Isuzu enters the '94 model year with small refinements to its four remaining model lines—the Amigo, Rodeo and Trooper sport/utes and the Isuzu Pickup.

Jaguar

Beyond their increasingly impressive quality, Jaguar's 1994 offerings pick up the pace in other ways: e.g., 301 **hp** on tap in the **V12-powered XJ12** sedan. Jag has also designed a 2+2 version of the **XJ-S convertible**.

Kia

All-new describes Kia's presence in the U.S. market. The Korean supplier of Ford Festivas has never operated here under its own brand name. But all-new doesn't exactly describe the car. The **Sephia** sedan has been on sale in Korea for a year or so.

Similar in size and performance to the Hyundai Excel, the Sephia is powered by an **88-hp 1.6-liter sohc 16-valve Four**. Transmission choices include a 5-speed manual (standard) or 4-speed automatic.

A value strategy is planned—well-equipped Sephias at an attractive price, starting at about $8500. The Sephia will go on sale initially in the

ISUZU RODEO

western states, to be joined in the spring by the **Sportage**, a compact sport/utility vehicle.

Land Rover

The company's impressively capable **Defender 90** is detailed in an accompanying Drive Report on page 53.

Lamborghini

Aside from its tenuous status as part of the Chrysler Corp., there's not much new at Lamborghini. The **492-hp 200-mph Diablo** continues to be one of the hottest street-legal cars you can buy.

Lexus

After whacking a long string of home runs, Lexus is taking a little break as '93 comes to a close. The only change of note is a **new 188-hp 3.0-liter dohc 24-valve alloy V6** for the **ES 300** sedan. The ES 300's 5-speed manual transmission option has been dropped.

Lotus

Lotus may not be a GM subsidiary any more, but the **Esprit S4** is still with us. Updates for '94 include chassis refinements, revised sheetmetal and new 17-in. alloy wheels.

Mazda

Although Mazda has a number of refinements for its cars—particularly its sports and sporty cars (see our Miata Drive Report)—its only truly new product for '94 is a truck.

Manufactured by Ford in New Jersey, the **B-Series** is a Ford Ranger with a number of Mazda cosmetic touches. The B-Series trucks include the full range of Ranger powertrain options—**2- and 4-wheel drive**, plus three different engines: a **100-hp 2.3-liter Four**, a **145-hp 3.0-liter V6** or Ford's torquey **160-hp 4.0-liter V6**.

While there are no sheetmetal changes elsewhere, there have been adjustments. Besides the new Miata motor, there's also a new base engine for the **MX-3** sport coupe—a **105-hp 1.6-liter dohc 16-valve Four**.

Mazda's world-class rocket, the **RX-7**, has had a little **civilizing** attention in the suspension department, as well as a softer rear antiroll bar for easier high-speed driveability.

At the small end of the spectrum, the Protegé sedan has had a modest **facelift**. And the 323 hatchback, originally scheduled for cancellation, will stay in the lineup.

Mercedes-Benz

Although Mercedes-Benz drew all sorts of size-related criticism for its big S-Class sedans, no one seems to be complaining about the **new C-Class** cars. Bigger than the previous 190-Class, the new sedans are roomier than their predecessors, as well as distinctly more agile.

And they're also peppier, thanks to thanks to a new Torsen limited-slip diff. And, yes, better power—specifically, a discernible improvement in torque.

So if you loved the original, you may find the sequel irresistible. —*T.S.*

KIA SEPHIA

DRIVE REPORT

MAZDA MIATA

MAZDA MOTOR CORPORATION

● The Miata's long-awaited horsepower increase is here at last, and we'd have to characterize it as subtle. If you thought the original 116-hp Miata was just fine, the 1.8-liter 123-hp version will represent an incremental gain. It's discernible, but far from nose-flattening.

In fact, the main reason Mazda installed the new engine was to compensate for more stringent emissions gear and small weight gains associated with safety improvements (dual airbags) and chassis stiffening.

While this modest upgrade may be disappointing to some, Mazda had a good reason for its restraint. Even though it's clearly a sports car, the Miata has so far escaped the kind of excessive insurance premiums that are killing some others, like the Toyota MR2.

Modest horsepower notwithstanding, the car that surrounds this new engine is distinctly better than its excellent predecessor. Better handling, thanks to the chassis stiffening. Better braking, thanks to bigger rotors. Better power delivery,

SPECIFICATIONS

Layout	Front-engine, rear-drive
Body style	2-door convertible
Engines	128-hp dohc 16V 1.8-liter I4 113-hp sohc 16V 1.8-liter I4
Transmissions	5M, 4A
Wheelbase	89.2 in.
Track, f/r	55.5/56.2 in.
Length	155.4 in.
Width	65.9 in.
Height	48.2 in.
Min. curb weight	2293 lb.
Brakes, f/r	Disc/disc, Opt: ABS

more power from both the base and upgrade engines. The former is a **147-hp 2.2-liter dohc 16-valve Four**, the latter a **194-hp 2.8-liter dohc 24-valve straight-Six**.

Like the rest of the Benz brigade, the C-Class cars continue to be rear-drive. Dual airbags and ABS are standard, traction control optional.

MAZDA B-SERIES PICKUP

Mitsubishi

Introduced in mid-'93, Mitsubishi's new **Galant** is the star of the corporate show for 1994. Redesigned—and significantly bigger—the new Galant sedan series has become one of the better bargains in the midsize class. Engine options are limited to a pair of **2.4-liter 16-valve Fours** as the model year opens, but the **twin-cam** version makes a robust **160 hp** and its handling is crisp.

MERCEDES-BENZ C-CLASS

Assembled in Illinois, the Galants are available in four trim levels—S, ES, LS and the sporty GS. Dual airbags are standard on all models.

Keeping pace with Toyota's new Supra Turbo, the **Mitsubishi 3000GT VR4** produces **320 hp** from its **twin-turbo 3.0-liter dohc 24-valve V6**. There's also new front and rear sheetmetal, a 6-speed manual transmission and bigger brakes.

Mitsubishi has also found more power for the **Montero SR** in a **new 3.5-liter dohc 24-valve V6** that delivers **215 hp** and **228 ft.-lb.** of torque.

MITSUBISHI GALANT

Nissan

A number of new cars are scheduled for introduction during the 1994 calendar year—the sporty **240 SX** coupe and convertible, the subcompact

DRIVE REPORT

SAAB 900

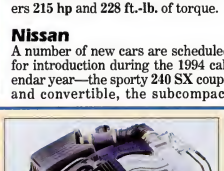
● "Very Saab." That's the launch slogan, and it reflects the concern that goes with the first new 900 in 15 years. Yes, it was certainly time for a new 900. But with a car—and owner body—as individualistic as the 900, it wouldn't do to lose touch with the mystique that set the original apart.

The concern was understandable, because a lot has changed at Saab, which is now a General Motors subsidiary. And that's been the key to Saab's survival. Without GM resources—specifically, Opel resources—new model development was all but beyond Saab's financial reach.

As a result, there's a fair amount of Opel in each new Saab 900, particularly in the floorpan. There's also a new 170-hp 2.5-liter 54° dohc 24-valve Opel V6 engine in the powertrain inventory.

If some of this sounds heretical, let us put your concerns to rest. The new 900 feels very much like the previous 900—with perhaps just a little more precision to its handling and a little more refinement to its ride. The ignition switch is right there between the front seats, where it belongs.

Best of all, it looks like a Saab 900, made attractively modern. It should make the faithful happy. —*T.S.*



SPECIFICATIONS

Layout	Front-engine, front-drive
Body style	4-door
Engines	133-hp dohc 16V 2.0-liter I4
	150-hp dohc 16V 2.3-liter I4
	170-hp dohc 24V 2.5-liter V6
	185-hp dohc 16V turbo 2.0-liter I4
Transmissions	5M, 4A, 5M auto clutch
Wheelbase	102.4 in.
Track, f/r	57.0/56.9 in.
Length	182.7 in.
Width	67.4 in.
Height	56.6 in.
Min. curb weight	2998 lb.
Brakes, f/r	Disc/disc, ABS

MITSUBISHI 3000 GT

Sentra and the flagship **Maxima** sedan. However, all will bow as '95 models. Changes for the '94 model year are minimal: Standard dual airbags for the popular **Altima** sedan and **300ZX** sports car, a driver's airbag for the **Quest** minivan and new instrument panels for the **Nissan pickup** and **Pathfinder** sport/utility.

Porsche

Like Nissan, Porsche is poised for a new-car launch—the **993**, due sometime early next year as a replacement for the current 911 family.

Rolls-Royce

Like their Bentley-badged brethren, the Rolls-Royce stable—the **Corniche IV convertible**, **Silver Spur III** and **Touring Limousine**—have had their **6.8-liter V8** engines tweaked for **20% more output.**

Saab

The new **900** is the subject of one of our Drive Reports. However, we should also note that the old **900 Convertible** will be in the lineup until midway through the model year.

Saab's high-end **9000** series, meanwhile, gets dual airbags plus the new and technically advanced Trionic engine-management system.

Subaru

There are no new Subarus for '94, but refinements abound. The compact **Impreza** gets dual airbags and a broader availability of ABS. There are several **value-oriented option packages** for the midsize **Legacy** lineup, Subaru's mainstream cars, and the swoopy **SVX** sport coupe get dual airbags, plus a cost-cutting front-drive-only option.

Suzuki

Aside from a new interior for the **Sidekick** sport/utility family, Suzuki's lineup is unchanged for '94.

Toyota

It's been a busy year at Toyota. Besides the **new Celica**, featured in a Drive Report, there's the sizzling new **Supra, a new Camry Coupe** and a **supercharged Previa** minivan.

The Supra, of course, has already drawn considerable attention, here as well as elsewhere. Tighter, lighter and more agile, the Supra comes in two flavors—fast **(225-hp 3.0-liter dohc 24-valve inline Six)** and faster **(320-hp 3.0-liter turbo)**. Stir in brash styling and you have a Supra that will make everyone forget its overweight, luxoboat ancestors.

The new Camry Coupe rounds out Toyota's successful midsize line. Like the rest of the Camry family, it's

TOYOTA CAMRY COUPE

PM PHOTO BY MIKE GASPAR

PM PHOTO BY MIKE GASPAR

DRIVE REPORT

TOYOTA CELICA

● Like Mazda, Toyota is making a religion out of weight reduction these days. Latest case in point: the 1994 Celica line—about 20% stiffer in the chassis department and 10% lighter at the curb.

This is a simplified Celica lineup compared to the previous generation. The fast-but-pricey All-Trac Turbo is gone, and trim levels are down to ST and GT editions for both body styles—coupe or liftback. An optional Sport Package, with stiffer suspension components, alloy wheels and more aggressive rubber, replaces the GT-S. And the new convertible is due midway through the model year.

There's a fair amount of Supra in the new Celica's styling, which we think is more successful than the off-planet look of the old car. And the redesigned interior has that fighter-plane feel that goes with a successful sport coupe.

But a more significant improvement, in our view, is how well the Celica responds to switchbacks and decreasing radii. New suspension subframing and rotary-valve power steering make handling—particularly the Celica GT, plus Sport Package—distinctly more precise than in years past. And even though power is about the same as it was, weight loss makes all-around response livelier. —*T.S.*

SPECIFICATIONS

Layout	Front-engine, front-drive
Body styles	2-door hatchback, coupe
Engines	110-hp dohc 16V 1.8-liter I4
	135-hp dohc 16V 2.2-liter I4
Transmissions	5M, 4A
Wheelbase	99.9 in.
Track, f/r	59.6/58.9 in.
Length	174.0 in.
Width	68.9 in.
Height	50.8 in.
Min. curb weight	2395 lb.
Brakes, f/r	Disc/drum; Opt: disc/disc, ABS

TOYOTA SUPRA

VOLKSWAGEN GOLF III

available with a **new aluminum 188-hp 3.0-liter dohc 24-valve V6.** Dual airbags are now standard for all Camrys. This goes for the Corolla, MR2, Supra and Previa, as well.

As noted, Previa will offer a supercharged engine option for '94, available on the LE trim level. The **blown version** raises output—from 138 to **161 hp**—and also improves mpg.

On the truck front, Toyota will offer a lower-price **4-cylinder** version of its new full-size **T100 pickup.**

Toyota has also added new side-door guard beams and a center high-mounted stoplight to all its pickups and its 4Runner sport/utility.

Volkswagen

VW's **Golf III** and **Jetta III** were due a year ago. However, problems with North American production delayed their arrival. To review: The Golf III hatchback and Jetta III sedan are more rounded and refined than their predecessors, as well as stiffer in the chassis department.

Base power for both cars is supplied by a **115-hp sohc Four.** Both will be available early next year with VW's celebrated **172-hp narrow-angle V6** engine. Both will get dual airbags in early '94, and both offer ABS and traction control as options.

Dual airbags will also find their way into the Corrado sport coupe and the Passat sedan by spring.

Volvo

As detailed in our Drive Report, Volvo's popular **850** line is enhanced by a **station wagon** and a **turbomotor** for 1994. The new model year also marks the end of the line for Volvo's stolid old 240 series.

As you'd expect, all Volvos have dual airbags and ABS. **PM**

DRIVE REPORT

VOLVO 850 TURBO WAGON

● If the only thing that's standing between you and Volvo 850 ownership is a desire for a little more horsepower, wait no more. By bolting a turbo to the 850's dohc 20-valve inline Five (2.3 liters in turbo tune), Volvo has found an additional 57 horsepower—225 total. *That* stirs the old lutefisk. The 850 body isn't what you'd call sleek, but 225 hp—the most ever offered in a Volvo—will hustle it up to highway speeds quicker than you can say ya shoor. More—it keeps on displacing the air well beyond what that squarish bow might suggest. We saw 150 mph on Volvo's big-banked oval test track outside of Gothenberg, Sweden.

Just as impressive were the 850's stability at these speeds and its handling.

The 850 Turbo is available in either sedan or new-for-'94 wagon body styles. And both will be offered with a handling package that stiffens things up a bit.

We prefer the wagon, for a couple of reasons. First, we've always been partial to Volvo wagons—they're well designed, roomy and well made. More important, they're stealthy. This is one hot herring-burner. —*T.S.*

SPECIFICATIONS

Layout	Front-engine, front-drive
Body style	4-door wagon
Engine	225-hp 2.3-liter dohc 20V turbo I5
Transmission	4A
Wheelbase	105.2 in.
Track, f/r	59.8/57.9 in.
Length	185.6 in.
Width	69.3 in.
Height	56.3 in.
Min. curb weight	3400 lb.
Brakes, f/r	Disc/disc, ABS

INSIDE THE IMPORTS

The race to remain competitive in '94 is evident under the skin.

BY PAUL WEISSLER

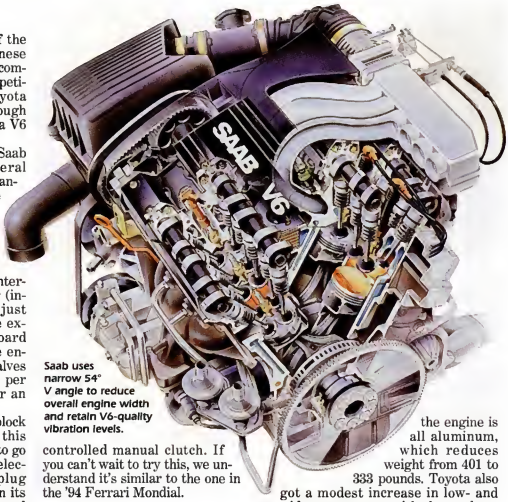
● Multivalve Fours get most of the engineering attention on Japanese and European cars, but V6s are coming on strong, to meet U.S. competition. Saab, Mitsubishi and Toyota have all-new '94 V6s, and although Honda refined its Fours, it has a V6 coming in '95.

The 170-horsepower 2.5-liter Saab engine was designed by General Motors of Europe. It has a 54° angle between the banks, close enough to the magic 60° to be inherently smooth, but compact enough to fit into a lot of other GM of Europe engine compartments. In addition, the valves are at different angles to the centerline of the combustion chamber (intakes at 23°, the exhausts at just 13°). The tighter angle for the exhausts (which are on the outboard sides) reduces the width of the engine at the top. There are four valves per cylinder and two camshafts per bank. The block is designed for an easy expansion to 3.0 liters.

The heads are aluminum, the block is recycled cast-iron—making this the first high-production engine to go "green." The V6 has a direct electronic ignition system (no plug wires), which Saab (and Olds on its Quad-Four) has long been using, and which you'll see on lots of other engines to meet upcoming legal requirements for engine computers to detect cylinder misfire. It's all a part of something called "OBD II" (second level, on-board diagnostics).

Many engines have oil coolers, but the new Saab V6 also has an oil warmer in the valley between the banks, under the intake manifold. It's a plate-fin heat exchanger, similar to some heaters. Engine oil and coolant circulate through the heat exchanger, bringing oil up to operating temperature faster. This not only reduces engine friction, but improves fuel economy and reduces cold-engine exhaust emissions.

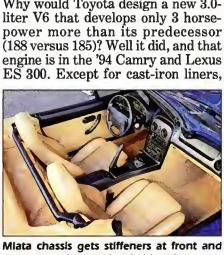
Late this spring, the V6 will be mated to an optional electronically controlled manual clutch. If you can't wait to try this, we understand it's similar to the one in the '94 Ferrari Mondial.



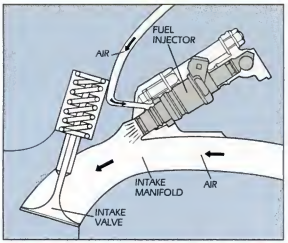
Saab uses narrow 54° V angle to reduce overall engine width and retain V6-quality vibration levels.

Toyota

Why would Toyota design a new 3.0-liter V6 that develops only 3 horsepower more than its predecessor (188 versus 185)? Well it did, and that engine is in the '94 Camry and Lexus ES 300. Except for cast-iron liners, the engine is all aluminum, which reduces weight from 401 to 333 pounds. Toyota also got a modest increase in low- and midrange torque, with the peak up from 195 to 203 ft.-lb. Many all-aluminum engines tend to vibrate and be noisy, but Toyota uses a structural aluminum oil pan integrated into a bottom-end stiffener for the block and very rigid aluminum brackets for the engine mounts. The engine is Toyota's lowest-friction design (narrow crankpins and journals, lighter valve springs and lower-tension rings). The bottom line for all these developments may be in the use of stainless-steel exhaust manifolds with ceramic "wool" insulation to hold in heat for faster warmup of the catalytic converter, high location of the piston rings and air assist for the fuel injectors (see Honda). These steps all reduce unburned hydrocarbons. In addition, the engine has



Miata chassis gets stiffeners at front and rear suspension and just behind the seats.



Additional air is ducted from the air cleaner into the fuel injector to assist in atomizing fuel.

a new crankshaft sensor and three oxygen sensors—the former to help with misfire detection, the latter to help the engine computer measure efficiency of the catalytic converter, both to comply with the upcoming OBD II. And the new V6 has a built-in coolant-fed heat exchanger to cool exhaust gases between the exhaust manifold and the intake manifold, so it can tolerate more exhaust-gas recirculation. EGR reduces another pollutant, oxides of nitrogen.

Toyota's potent new 320-horse Supra Turbo picks up a development from the racetrack, but it's in the stop-faster department: ventilated front brake discs that are not just the simple radial paddle-wheel vanes, but which are spiral turbocharger-type vanes to pull cooling air through the center of the rotor.

Mitsubishi

Engines in sport/utility vehicles are getting as sophisticated as those in cars, and with smoothness to match, as you'll see in Mitsubishi's new 24-valve 3.5-liter V6 for the '94 Montero. This engine develops 215 horsepower at a relatively high-revving 5500 rpm, but the maximum torque of 228 ft.-lb. comes in at a moderate 3000 rpm. The balanced performance is partly provided by a split-tuned intake manifold, with a computer-controlled butterfly valve. At less than 3200 rpm, the air flows through long, narrow runners. At more than 3200 rpm, it flows through short, wide runners, for good cylinder filling in each case.

The engine has lots of features intended to reduce noise and vibration, ranging from 4-bolt main-bearing caps in a wide rigid girdle, a forged-steel crank, to a dual mass crankshaft damper built into the crank pulley. A conventional single-mass outer damper can be mounted in a rubber that provides good damping of torsional vibration in the one rpm range (typically low rpm). The second damping mass adds control that extends up to high rpm.

The engine also has downsized fuel injectors, and because they're smaller and lighter, they make a lot less noise. You may not isolate injector noise from other engine sounds, but it's all part of the package that the engineers work on.

The 3.5-liter V6 has a redesigned fast idle system that smooths out the idle during warmup. Gone is the thermostat-type air valve, which is not the most precise thing you can use (it's the reason why cooling-system thermostats aren't so exact). Instead, the engine relies on the computer controlling a high-airflow-rate stepper motor. The computer looks at signals from air- and coolant-temperature sensors, which are a lot more accurate. In case the stepper motor fails wide open, there's a temperature-sensitive bimetallic strip that serves as an rpm limiter.

Most of Mitsubishi's passenger-car engines have an additional oxygen sensor after the catalytic converter, which is also in preparation for OBD II.

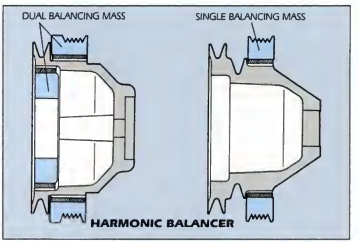
Honda

Honda's V6 may not be ready, but the 2.2-liter 16-valve 4-cylinder got a major reworking for the new Accord. It's a 145-horse version with Honda's novel version of variable-valve timing that not only changes the timing but the cam-lobe profile, as well. In the Accord, one intake valve opens more than the other at part throttle, which creates an air swirl for better mixing with the injected fuel. This combines with a fuel-injector air-assist system, activated through a solenoid valve by the engine computer. When the solenoid is opened at about 1300 rpm, air from the inboard side of the air cleaner is drawn through calibrated orifices in the fuel injectors to help atomize the fuel. Although air assist is not new (Toyota began using it in the idle circuit in 1992), Honda's control through a solenoid valve is different, as is its integration with the variable-valve timing. The design changes produce surprisingly good low-end torque for a 16-valve 4-cylinder engine, and Honda's usual great off-idle launch feel.

At higher rpm (2300 to 3200, depending on operating conditions), the Honda computer switches the engine to a high-performance valve lobe.

Honda always pays attention to the details, and the new Accord contains close to 100 versions of one example: a trim clip that can be installed with almost no effort, compared with the conventional multiflute "Christmas tree" design. The new clip—which latches once it gets past the single step, unlike the Christmas tree—is immune to fairly large variations in hole size, because it expands once it's inserted, similar to some of the plastic clips used to hold screws in hollow household doors and walls. Because it takes about 3 pounds of force to seat (one-seventh of the pressure of a Christmas tree), it gets installed correctly even at the end of a day by a tired worker. This is one good idea that didn't come from Japan—it was developed by Honda's U.S. assembly-line workers.

The '94 Acura Integra is a new model, and it gets an optional 170-horsepower 1.8-liter 4-cylinder engine with variable-valve timing. In this case, the variable timing is designed almost entirely for high output, as the peak horsepower is at 7600 rpm. In order for the engine to tolerate that kind of high rpm without increasing the bearing size, Honda uses a new process to change the surface of the connecting rod bearing overlay. Under a microscope, it appears to be a pointy mountainous area compared with the conventional rounded surface. Rounding might seem to be smoother, but the valleys between the mountain tops hold oil much better. And the bearing actually has 35% greater durability,



Second balancing mass on the crank pulley of the '94 Mitsubishi Montero assists in reducing vibration at higher rpm.

despite the fact that bearing width was reduced slightly. The new bearing was developed by Honda for its Formula One engine.

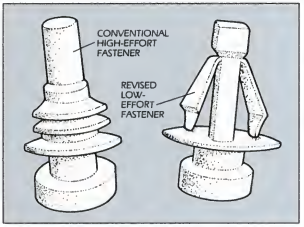
Honda's highest-performance engine is a variable-valve timing 1.6-liter Four, optional in the '94 del Sol. It develops 160 horsepower at 7600 rpm, 100 per liter—the highest of any naturally aspirated mass-produced engine in the world.

Volkswagen

If low-end torque is what people really want, perhaps the answer is a 2-valve engine, and if it has overhead cams, it can produce a reasonable amount of horsepower, too. That's VW's approach with its new 2.0-liter 4-cylinder engine, and they lengthened the stroke of the 1.8-liter from 89mm to 95.5mm to get the added displacement. Stroking is a good way to get more torque, and the engine produces 122 ft.-lb. at 3200 rpm (and 115 hp at 5400 rpm). Volkswagen increased the length of the block 16.5mm and the length of the connecting rod 15mm (to 159mm), which reduces the angular changes the rod must make as the piston goes up and down. This cuts engine vibration. VW even put a cylindrical vibration damper on the shift linkage to absorb vibration normally transmitted from the powertrain through the linkage to the shift lever.

Mercedes-Benz

Look under the hood and under the body of the new Mercedes-Benz C-Class cars (replacing the 190-Class) and you'll see a lot of "Why did they do that?" revisions. The answer may be to improve structural integrity in a crash. Examples: The front crossmember, made of high-strength steel, is full width and connects to the front longitudinal rails with triangular sections for crash-load distribution. The rails are thicker as they approach the passenger compartment, providing progressive crush resistance. At the firewall, the rails split into three branches, each of which ties into an A-pillar, the transmission tunnel and a floor-rail member (it's the latest version of a basic Mercedes crash-protection approach). The rears of the front wheel wells are high-strength steel and tied to the A-pillars, to keep the suspension arms from being pushed through. And under the hood, many components are staggered, so one component can't directly push another rearward into the passenger compartment.



Honda factory workers developed an easy-to-insert trim fastener that uses only 3 pounds of push to seat.

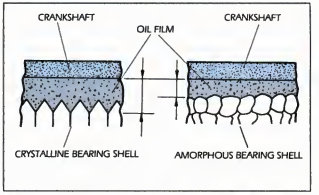
Mazda

The Miata becomes even more of a handling sports car in '94. There's a little more displacement and power in the 16-valve 4-cylinder—up from 1.6 liters and 116 horsepower with a single overhead cam to 1.8 liters, 128 hp and dual overhead cams. Additionally, a Torsen limited-slip rear differential is being installed to reduce wheelspin during cornering, in place of the viscous-coupling type. The big changes were made to reduce body flex, so the car can handle better. Mazda installed transverse steel bars in the front suspension (between the lower arm assemblies), in the passenger compartment (between the seatbelt anchor towers behind the seatbacks) and two in the rear (connecting each suspension arm assembly to the rear crossmember).

BMW

There's a new input to the elaborate computer systems on '94 BMWs with dual airbags: a passenger. The seat cushion contains a special pressure-sensing transducer wired to the computer, so the airbag deploys only if there seems to be a passenger. And instead of simple impact sensors in front, there's a single electronic accelerometer in the computer housing. The accelerometer signal is analyzed by the computer, and the airbags deploy only if the crash is severe enough. In a very modest crash, if the seatbelts are fastened, the bags stay in place. If the crash justifies, the bags will deploy even if the seatbelts are fastened and, under some conditions, this includes the passenger's airbag even if there is no passenger (to cover the remote possibility of a seat-sensor circuit problem that fooled the computer's diagnostics).

BMW also is using electronic controls to tailor powertrain performance more closely to the driver's tastes, even if they suddenly change. On the 850CSi, this means if you're tooling along in a super-conservative good-gas-mileage mood and suddenly come to a stretch of wonderfully twisty roads too good to resist, flip a dashboard switch and the computer will take note of your intended change in driving technique. The gas pedal is actually a variable resistor that signals the engine computer (no cable connection), so now when you step hard on the gas pedal, the computer opens the throttle faster.



Aligned, pointy structure of Acura's crankshaft bearings holds thicker oil film, which adds to bearing life.

Many automatic transmissions have computers with "adaptive" strategies that can vary shift schedules on grades, but BMW's '94 5-series V8 trannies give you a basic choice and take it a long way from there. Flip a switch to S for Sport, and the shift points are raised. In the A position, the computer strikes a balance based on how you normally drive and throws in adjustment factors for slick winter roads, up and down grades, even heavy traffic. The '93 computer had a few possible shift schedules. The '94 looks constantly at many more aspects of the way you drive, and it can choose from a laundry list of possible subroutines.

BMW didn't forget raw performance. The '94 V12 produces 372 horsepower, up from 296. The increase comes from more displacement (up from 5.0 to 5.6 liters) and general tuning. The engine is the most powerful BMW has produced, and although it's under the 389 hp of rival Mercedes-Benz's 6.0-liter V12, it produces slightly more horsepower per liter. **FM**

For Those Who've Already Set Themselves Apart From The Crowd.

The fly-fisherman thoughtfully working the remote mountain stream no more resembles the typical weekend angler than the Toyota T100 resembles the typical pickup truck. For unlike any other truck, the Toyota T100 in its introductory year was ranked, *based on T100 owner surveys*, The Best 'Full-Size' Pickup In Initial Quality.[1]

T100's New Standard Driver-Side Air Bag.

Do not be mislead by the ease at which Toyota accumulates such awards. The new qualities that surface in a vehicle such as the 1994 Toyota T100, standard driver-side air bag* and side-door impact beams, can be directly linked to Toyota's commitment to remaining a leader at providing customer satisfaction. The same is true of the Toyota T100's unique size. Big enough to provide for impressive payload/towing capabilities, yet not so big as to impair performance and agility. As for the level of comfort found in the Toyota T100's quiet car-like cabin, only the word 'unexpected' seems fitting. Clearly the Toyota T100 puts you in a whole new class of truck. But you already knew that.

TOYOTA T100

"I love what you do for me."

Call 1-800-GO-TOYOTA if you'd like a Toyota T100 brochure and the location of your nearest dealer. *Always use your seatbelt. Driver-side air bag is a Supplemental Restraint System (SRS). [1] J.D. Power and Associates 1993 Light Truck Initial Quality Survey.® Based on a total of 11,719 consumer responses indicating owner-reported problems during the first 90 days of ownership. Buckle Up! Do it for those who love you. © 1993 Toyota Motor Sales, U.S.A., Inc.

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Step right up! See the BT3000 Precision Woodcutting System from Ryobi with your own eyes! Because for those with a passion for wood, there is no greater thrill. Like the unique sliding miter table with its oversized miter fence and giant miter scale for unparalleled accuracy. A patented

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HOME IMPROVEMENT

SURFACE WIRING

The painless way to upgrade your electrical system.

TEXT AND PHOTOS BY MERLE HENKENIUS

● Much of the dread of making an electrical upgrade is based on the need for cutting into finished walls and ceilings. Fishing wire through closed spaces is always a gamble as hidden structural components can foil the entire effort. Then, of course, there's the problem of wiring along brick or masonry walls.

One solution to these problems is decorative surface wiring. While not the most desirable option under ideal conditions, the system can be a real problem solver in the right places.

Surface wiring is not a new concept, we've all seen it in old schools and commercial buildings. The difference today is that modern surface wiring components are not only attractive, but also come in a range of colors and profiles. Some are also made of plastic, which eliminates the need for redundant grounding.

Choosing components

We chose components made by the Wiremold Co. A typical installation of one new receptacle and a switched ceiling light requires enough channel to reach the new box locations, three box extensions, a T connector to branch to the switch, an inside-corner connector to carry the channel across the ceiling and a round ceiling fixture box. You also need a few accessory packets that include an assortment of wire clips, track connectors, screws and plastic anchors.

In addition, you need wire connectors, a standard single-pole switch, a receptacle, a ceiling light and No. 14 insulated wires. You need one black, one white and one green wire for each device that is to be wired.

Code considerations

Several electrical code requirements will rule your installation. To determine whether your circuit has enough capacity for the new components, assign 1.5 amps to each exist-

ing outlet. At this rate, a 15-amp circuit will handle 10 outlets, and a 20-amp circuit will handle 13 outlets. Shut off your circuit and use a lamp to verify which outlets are without power. Then, add up the number of dead outlets to determine how many new fixtures or boxes can be added.

Each receptacle and fixture also needs to be grounded, as does any metallic box you use as a starting point. All ground connections should be made with insulated wire, and all wires should be the same size as those used in the existing circuit.

Also, check with local codes for the number of wires allowed per box. You are allowed to count all ground wires as one and each device as one. Generally speaking, you are allowed six wires per track and box.

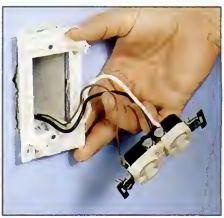
Getting Started

The Wiremold system consists of wire channels, channel connectors, box extensions and box baseplates. The 2-piece channels are composed of a base channel that's screwed to the wall and a trim channel that covers the wires. The wires are held in place with thin plastic clips that attach to the base channel, and snap-on connectors conceal the joints between connecting channels.

Each baseplate and box has knockouts, so that the base channel will extend slightly into the box baseplate and the trim channel will extend into the box extension. Choose the knockouts that will provide the best entry point for each receptacle or switch. Make the knockout cuts with a sharp utility knife, and break off the tabs with pliers (Photo 1).

1 Before installing each box baseplate, use a utility knife to cut the ends of the knockouts, and snap them off with pliers.

Next, determine the outlet to use as the power source. Shut off the power at the panel, remove the coverplate from that box and pull out the receptacle. Then, slide the baseplate over the existing box (Photo 2), and screw it to the wall with the anchors provided in the accessory kit.



2 After unscrewing the receptacle from the power-source box, slip on the new baseplate and secure with anchors.

Installing The Channels

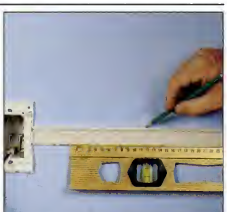
After the baseplate at the power-source outlet is in place, it's time to cut and position the first length of base channel. When bringing the channel to a new outlet box, first cut the base channel to length with a pair of tin snips or a hacksaw (Photo 3) and bore screwholes every 18 in. Insert one end of the base channel into the power-source baseplate knockout, and use a level to align the piece accurately so that it is parallel to the floor (Photo 4).

While holding the channel level, mark each drywall anchor-hole location on the wall. Then, use an awl to punch the anchor holes into the drywall. Use a hammer to tap the anchors into place, and screw the base channel to the wall.

To run wires to a switch box or ceiling light fixture, add a vertical section of base channel to create a T joint. At the T, break a section from the edge of the continuous horizontal channel to make a space to run the wires. Then, mark and punch the anchor-hole locations and fasten the adjoining base channel in place with screws (Photo 5).

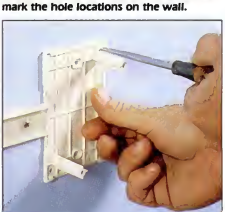
After fastening each length of base channel that will join a box baseplate, secure the baseplates to the wall with the knockouts removed (Photo 6). Continue adding base channel and

3 Use tin snips or a hacksaw to cut the base channel to length. Use a hacksaw only when cutting the trim channel.



4 After boring holes through the channel on 18-in. centers, level the channel and mark the hole locations on the wall.

5 Secure the channel with drywall anchors and screws. At a T connection, break away the edge to make room for the wires.



6 Use an awl to punch anchor holes through the baseplates and wall. Then, attach with drywall anchors and screws.

7 Lay the wires into the channel and use wire clips to hold them in place. Use wires of the same size as the original circuit.

8 With wires in place, measure the trim channels exactly and snap them in place over the base channels to conceal wiring.

9 Snap connectors over the trim channels at T and L branches. Trim channels extend under connectors about ¼ in.

box bases in the same manner until you've completed your circuit extension layout.

With the channel and box layout completed, lay the wires into the base channel and snap wire clips over them to hold them in place (Photo 7). In our case, we ran two sets of three wires from the existing receptacle—one to a new receptacle box and one branching off to a new switch and ceiling box.

When measuring and cutting the trim channels that cover the wires, it's best to hold the extension boxes and connectors in place to determine the exact length of trim channel that's needed. Inline, corner and T connectors have built-in stops that require an exact fit. Only about ¼ in. of channel is actually covered by each end of the connector or the extension box. While holding each extension box or connector in place, mark the exact trim channel cutoff location on the base channel.

Then, hold the trim channels in place and mark the cutlines as indicated on the base channel. After cutting each length of trim channel with a hacksaw (don't use snips for the trim channel), snap it in place over its base channel, again, using the pencil-marks as a guide (Photo 8). Then, install the connectors where required to conceal the wires (Photo 9).

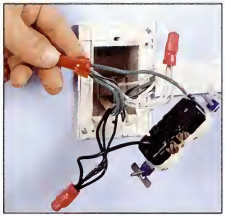
Wiring The New Devices

After the base channels, trim channels, connectors and box baseplates are in place, it's time to connect the wires and install the extension boxes and coverplates. Before installing the boxes, connect the new wiring to the power-source receptacle and wire each new receptacle.

To connect the wires at the power-source receptacle, first remove the receptacle and install insulated pigtail wires to its hot, neutral and ground terminals. To keep it simple, the brass-color terminal gets a black wire, the silver-color terminal gets a white wire and the green terminal, a green wire. Use the appropriate-size twist connectors to join all like-color wires in the box with those of the receptacle (Photo 10).

Wire the remaining receptacles with pigtails, and the last receptacle without pigtails. Use the same black, white and green color-code assignments as before.

To mount the extension boxes, first use a utility knife to cut the ends of the appropriate knockouts (Photo 11), and snap off the knockouts with pliers. Mount the boxes to the baseplates with screws (Photo 12). With the boxes in place, simply secure the receptacles to the boxes in the usual manner (Photo 13). Finally, install the receptacle coverplates.



10 At the source box, use pigtail connections to attach receptacle and new wiring. Join together all the same-color wires.

11 Use a utility knife to cut the ends of knockouts in the extension boxes. Then break away the knockouts with pliers.

12 To mount the extension boxes, simply screw them to the baseplates. Pigtails are not required at the end of the circuit.

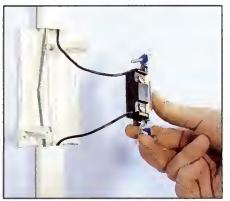
13 Finally, install the receptacles in the extension boxes just as you would in an ordinary in-wall receptacle box.

Wiring A Switch And Ceiling Light

If you've laid out your channels and box bases for a new ceiling light and wall switch, these components should already be in place, with the wire, channel trim and connectors installed. We connected the vertical channel to the receptacle channel with a T joint, and, after joining the switch baseplate, we carried the channel around the ceiling corner with an L connection.

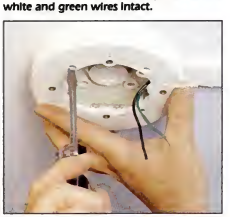
Wiring the switch is really a snap, because only the hot (black) wire is diverted through it. Cut the black wire and connect the ends to the two switch terminals, leaving the white and green wires intact (Photo 14). After mounting the switch, install the switch coverplate (Photo 15) and move on to the ceiling light. First, install the ceiling box and pull the wires down through it (Photo 16). Then, use twist connectors to join the fixture leads to the circuit wires. Again, join black wire to black wire, white to white and green to green (Photo 17). Then mount the fixture, install appropriately rated bulbs and attach the globe or diffuser.

Finally, turn the power back on at the panel, and put your new extended electrical system to work. PM

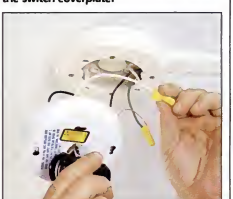


14 To install a simple single-pole switch, connect the black wire only. Leave the white and green wires intact.

15 After the switch is wired, secure it to the extension box with screws and attach the switch coverplate.



16 Fasten the ceiling box extension to its baseplate with screws before connecting the wires to the ceiling fixture.



17 To wire the ceiling fixture, join all like-color wires with twist connectors. Then, install the bulb and diffuser.

SOURCES

TRADITIONAL HARDWARE BY MAIL

● When it comes time to find traditional hardware, you could run down to the local hardware store. However, don't be surprised if nothing fits right or looks the part. The right stuff is around, you just have to know where to look.

To help, here's a list of mail-order retailers of traditional hardware. Some companies, such as Ball And Ball and Faneuil Furniture Hardware, deal exclusively in furniture hardware, while others, such as Renovator's Supply and The Antique Hardware Store, sell everything from sink fixtures to weathervanes.

You'll also find a modest hardware selection in many woodworking catalogs including Woodcraft, 210 Wood County Industrial Park, P.O. Box 1686, Parkersburg, WV 26102 and The Woodworkers' Store, 2180 Industrial Blvd., Rogers, MN 55374.

—Thomas Klenck

PM PHOTO BY LANCE BEKER

SOURCE LIST

● The Antique Hardware Store, 9730 Easton Rd., Rt. 611, Kintnersville, PA 18930; (800) 422-9862.

● Renovator's Supply, P.O. Box 5000, North Conway, NH 03860; (800) 659-3211.

● Garret Wade Classic Hardware, 161 Avenue of the Americas, New York, NY 10013; (800) 221-2942.

● Hardware+Plus Inc., 701 E. Kingsley Rd., Garland, TX 75041; (800) 522-7336.

● Crown City Hardware Co., 1047 N. Allen Ave., Pasadena, CA 91104.

● Ball And Ball, 463 W. Lincoln Hwy., Exton, PA 19341.

● Faneuil Furniture Hardware, 163 Main St., Salem, NH 03079.

HARDWARE

LOCKS

The key to peace of mind starts with a simple piece of hardware.

TEXT AND PHOTOS BY MERLE HENKENIUS

● When it comes to protecting your home and possessions, you have a few alternatives to choose from. You can install an electronic alarm system, or you can hook up with an agency that will keep tabs on your house while you're away. You can also get a big dog—one that's trained to be wary of strangers and expects to be fed and cared for each day. However, the first line of defense is quite a bit simpler than any of the above—and quite a bit cheaper, too. All it involves are a few locks. They're easy to install, don't require monthly payments and not likely to intimidate the babysitter the next time you go out for dinner.

You might not spend a lot of time thinking about locks and locksets, but the list of options has grown a bit in recent years. While the traditional and familiar are still very much in demand, manufacturers have also worked to improve security and to make the functional, fashionable. Specialty locks, too, are more commonly available as lifestyles change and markets expand. Let's begin with a brief overview, starting with doorsets.

Household locksets can be divided into several basic categories, with the location of the door dictating the lock type and style. Entry locksets, found on front and back house doors and garage passage doors, are usually keyed, and may be combined with auxiliary deadbolts for better security.

Next on the list are bed-and-bath locks. These locksets contain simple, easy-to-jimmy mechanisms that seldom come with machined keys. Privacy is the issue here, not security. And finally, your home will include a few doorsets that do not lock, which are typically used on hall and closet doors.

These examples are the most obvious and familiar, but many households also support an array of permanently installed secondary locks, such as those found on windows, patio doors and cabinets.

And finally, most of us use padlocks and other general-purpose locks to secure tools, garden equipment, boat trailers, bicycles and the like. Our survey includes a little bit of everything—from the common and affordable to a few of the more arcane and costly models. Keep in mind that this is a general overview. Most manufacturers offer a wide assortment in style, utility and price. If the lock you're looking for isn't shown here, there's a good chance it is available, either at your local hardware store or home center, or through a locksmith.

1. Keyless-Entry Deadbolt Locks— Keyless, programmable locks have been around for some time and are available in mechanical pushbutton designs or as electronically controlled models. Instead of a traditional key, they utilize a personalized programmable code. The advantage of this is fairly obvious—there are no keys to copy, distribute and lose. The pushbutton Simplex 6000 residential lock shown is a reliable mechanical design that features a personal entry code that's programmed at the time of installation. And, you can easily change the code at a later date without removing the lockset—another distinct advantage over standard keyed locks.

1

The locksmiths we spoke to favor the mechanical keyless locks over the electronic, as electronic models require wiring or batteries and can forget their entry codes in the presence of too much static electricity. The mechanical Simplex 6000 costs about $200. For more information, contact Simplex Access Control Corp., 2941 Indiana Ave., P.O. Box 4114, Winston-Salem, NC 27115.

2. Multi-Lock Devices—This device, called a Safety Lockout, is designed for situations in which you want more than one person around when the lock is opened. It's actually not so much a lock, but a lock accessory. It allows two or more people to have joint access to a property, but only when all parties are present. Each brings his own padlock to the bargain, and only when all locks are removed will the lock release. The Safety Lockout costs around $7, and is made by the American Lock Co., 3400 W. Exchange Rd., Crete, IL 60417.

3. Locks For Lockers And Toolboxes—Locks made for recessed locker and toolbox latches are designed with wide, slender shackles, usually made of hardened steel that resists cutting with a hacksaw. Wide-arc shackles are vulnerable to boltcutters, however, and are therefore medium-security locks intended for light-duty deterrence.

This Master Pro-Sport lock is a combination lock than can be programmed easily, with 10,000 possible number combinations. This lock sells for around $10, and is made by the Master Lock Co., 2600 N. 32nd St., Milwaukee, WI 53210.

4. Covered Padlocks— Covered padlocks are designed to be used outdoors, where exposure to the elements might otherwise be a problem. In addition to being made with materials that resist corrosion, most of these locks are covered in weather-tight, chemical-resistant plastic. Not only does the plastic armor keep moisture and corrosives, like road salt, from the inner workings, it also keeps the lock from scratching the equipment that it secures.

The Master Lock model 3DCOV shown here also offers good security, as it's made of laminated steel and has a more complex pin-tumbler mechanism than ordinary padlocks. A problem manufacturers face is that the most secure lock mechanisms are also the most vulnerable to weather and chemical corrosion. As such, the fit of the covering that protects the lock is critical. The Master Lock model 3DCOV carries a lifetime warranty, and costs about $9.35. For more information, contact Master Lock Co., 2600 N. 32nd St., Milwaukee, WI 53210.

2 3 4 5 6

5. Combination Cable Locks— Cable locks are used to secure bicycles, lawnmowers, trailers and just about anything you'd like to tie down that doesn't have a hasp. The cable can be threaded through wheels and frames when moderate security is needed.

This Kryptonite model comes with a 4-digit combination lock that can be programmed and reprogrammed easily. The unit shown here (Model RCL, about $13) has a company security rating of 2. A level 5 is Kryptonite's toughest cable lock. For more information, contact Kryptonite Corp., 95 Freeport St., Boston, MA 02122.

6. Super-Secure Padlocks—Most padlock manufacturers offer a wide range of locks to meet the compromise between your monetary budget and your security requirements. If you're interested in maximum security regardless of the price, you should check out at least one of the top-end, industrial-grade, can't-kill-it-with-a-hammer padlocks. The one that is shown here is made by Abloy Security Group and has many of the features that are found in typical industrial-grade models.

To begin, its large, heavy $3\frac{1}{8} \times 3\frac{5}{8}$-in. body is machined from a solid block of hardened steel. The 14mm-dia. case-hardened steel shackle is

shielded by a raised shoulder that would frustrate the most patient attempts at sawing, cutting or assaulting. The internal mechanism contains 11 locking discs, and the key cannot be removed until the shackle is in the closed position.

Where would you use such a lock? You probably wouldn't, but it is sort of fun to think about. Abloy makes locks starting at around $20, but this model, No. 3095, would set you back about $235. For more information, contact Abloy Security Group, 6200 Denton Dr., Dallas, TX 75235.

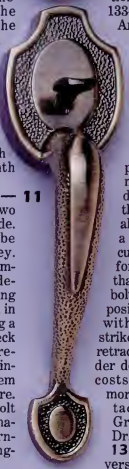
7. Combination Lockset/Deadbolt—If you'd like to add a deadbolt to your front door, but dread poking a hole in an expensive component of your home, then a combination lockset/deadbolt will have real appeal. The Weiser Deadbolt allows you to use the existing holes of your present lockset. It's a simple one-for-two swap. In the bargain, you get a 1-in. deadbolt that looks like a standard knob-type lockset. Using extra-long screws, the strike plate is fastened through the jamb and into the jack stud of the framed wall. The Weiser Deadbolt costs about $30. For more information, write Weiser Lock, 6660 S. Broadmoor Rd., Tucson, AZ 85746.

8. Glass Patio-Door Locks—Sliding glass doors don't do much to discourage intruders, but there are a few auxiliary locks that can make your door a little less inviting. One example is this keyed patio lock offered by Belwith International Ltd. This bolt-type lock mounts directly on the door frame, with the bolt sliding into the lockpiece. The lock keeps the door from moving from side to side or being lifted from its track. The bolt will also rotate to keep from being cut with a hacksaw. The Belwith patio-door lock sells for around $18. For more information, contact Belwith International Ltd., 18071 Arenth Ave., City Of Industry, CA 91748.

9. Two-Cylinder Deadbolts—This type of deadbolt lock has two keyed cylinders—one on each side. As such, the deadbolt cannot be locked or unlocked without a key. Two-cylinder locks are often recommended for doors that have sidelights, because an intruder breaking the glass wouldn't be able to reach in and open the lock. Before installing a 2-cylinder deadbolt, however, check with local codes. Because they require a key to open, even from the inside, authorities often consider them escape-hazards in the event of a fire. This Lori Lock 2-cylinder deadbolt costs about $44. For more information, contact Lori Lock, Old Turnpike Rd., P.O. Box 1040, Southington, CT 06489.

10. Window Locks—Most windows come with some form of locking device, but for added security, you might consider installing one of these simple, keyed bolt locks. The unit mounts easily on the frame of a window pane. One advantage is that a second strike plate can be installed several inches above that of the closed position plate, so that the window can be locked in a ventilating position. Again, for fire safety, everyone in the house should have access to keys. The Wright keyed window lock shown here costs about $9. For more information, contact Wright Products Inc., 107 W. Coleman, Rice Lake, WI 54868.

11. Entry Handlesets—Handlesets have been around for years and are making a strong comeback. Because keyed locks are difficult to achieve in traditional handlesets, most come with auxiliary deadbolts that provide the necessary security for exterior doors. This Weslock handleset and deadbolt costs about $48. For more information, contact Weslock, 13344 S. Main St., Los Angeles, CA 90061.



12. Single-Cylinder Deadbolts—Most single-cylinder deadbolts key from the outside, but can be operated from the inside with a simple thumb-turn. This particular model, made by Abloy, does double duty, as the thumb-turn knob can also be operated with a key. Additional security is offered in the form of ball bearings that protrude from the bolt when in the locked position. As the bolt is withdrawn from the strike plate, the bearings retract. This single-cylinder deadbolt from Abloy costs about $165. For more information, contact Abloy Security Group, 6200 Denton Dr., Dallas, TX 75235.

13. Leversets—A leverset is simply a stylized lockset. In addition to adding a bit of elegance to a home's decor, leversets are easier to use, even with both hands full. They are also less troublesome to operate for small children and those with arthritis. This Weiser bed-and-bath leverset costs about $13. For more information, contact Weiser Lock, 6660 S.

Broadmoor Rd., Tucson, AZ 85746.

14. Lever Doorsets—Leversets are also available without locks. This Schlage hall-and-closet doorset offers another opportunity to make hardware part of your decorating scheme. Leversets, by the way, must be ordered for left- or right-swinging doors (as noted with your back to the hinged side of the jamb). This Schlage leverset costs around $31. Contact Schlage Lock Co., P.O. Box 193324, San Francisco, CA 94119-3324.

15. Bike Locks—With more expensive bicycles comes the need for more substantial bike locks. This familiar configuration has a large U-shape shackle that locks into a keyed cylinder. The size and shape of the shackle allows it to secure both the frame and the wheels. A plastic coating protects the lock and the bike from scratches. This Kryptonite lock sells for around $30. For more information, contact Kryptonite Corp., 95 Freeport St., Boston, MA 02122.

16. Keyed Hasp Locks—We're all familiar with hasps made for padlocks, but this hasp comes with its lock built-in. The operation is the same, except that when keyed, the lock body rotates across the hasp hinge. This keyed hasp, made by Wright Products, costs about $6. For more information, contact Wright Products Corp., 107 W. Coleman, Rice Lake, WI 54868.

17. Screen And Storm Door Locks—While screen and storm doors can offer some deterrence, the locks we install on them are more for privacy than for anything else. This simple brass mortise lockset can only be locked from the inside. Called the Dexter lock, it's made by Master Lock and costs around $16. Contact Master Lock Co., 2600 N. 32nd St., Milwaukee, WI 53210.

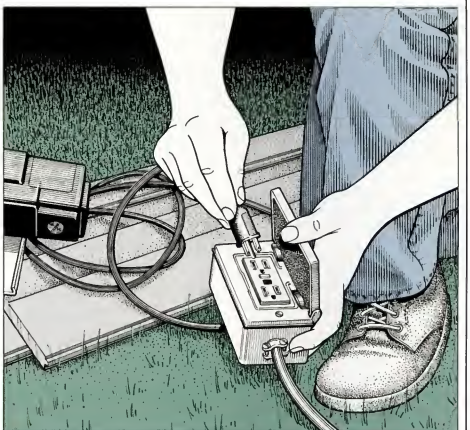
18. Keyed-Entry Knobsets—This is probably the most popular style of entry-door lockset. With this model, the outside is keyed and the inside is locked with the turn of a button. This Schlage keyed-entry lockset costs around $35. For more information, contact the Schlage Lock Co., P.O. Box 193324, San Francisco, CA 94119-3324.

19. Rim Locks—Rim locks have been around for generations, offering the appeal of easy installation. As the body of the lock is screwed directly to the inside of the door, you don't need to drill the door as you do with a mortise lock. Its vertical locking-pin also makes it useful for double doors. The downside of any surface-mounted lock is that its screw surface mounting means that the door can be more easily forced than traditional deadbolts. This Ace Hardware lock (made by ILCO-Unican) costs about $18. Contact Ace Hardware Corp., 2200 Kensington Ct., Oak Brook, IL 60521. PM

HOME IMPROVEMENT

MAKING A GROUND FAULT EXTENSION CORD

BY GENE & KATIE HAMILTON
PM Illustrations by George Retseck



● Your best guarantee of safety while using electrical tools outside or in damp areas is to be sure that everything you use is plugged into a GFCI or ground fault circuit interrupter. This electrical device instantly detects a hazardous situation and cuts the flow of power before a fatal shock is delivered.

It's true that current electrical codes require outside outlets and those in the bathroom and kitchen or in damp areas to be protected by a GFCI. New homes must have these protective devices, but homes built prior to 1974 have only grounded circuits with a circuit breaker or fuse protector. Neither is as safe as GFCI protection in conjunction with a fuse or circuit breaker.

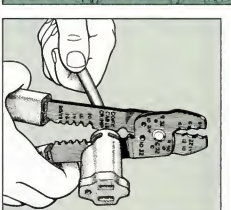
Also, double-insulated tools and tools with a heavy-duty 3-wire grounded cord offer good protection against shock, but their safety feature can be interrupted by accident or improper use.

GFCI devices are inexpensive and easy to install. It's a simple job to add a GFCI to a 3-wire cord. To do this, you replace the receptacle end of the cord with a GFCI receptacle housed in a weatherproof box.

How a GFCI works

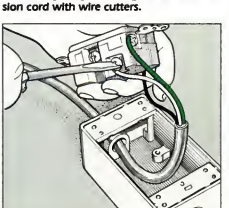
A GFCI device senses current (amps) flowing to and from electric tools and equipment. Under normal operating conditions, the current flowing to the tool is the same as that returning to the electrical panel. When a ground fault occurs, some of the current is diverted to the ground by a short somewhere in the circuit. If the short is through you to the ground, you are in for a shocking experience.

The GFCI senses current-flow imbalance. It can detect a current imbalance as little as 5 milliamps (which

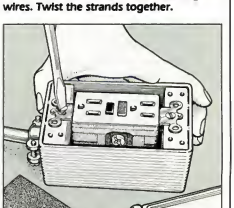


1 Begin by cutting off the receptacle end of a heavy-duty 3-wire grounded extension cord with wire cutters.

2 Strip off ½ in. of insulation from the end of the cord's black, white and green wires. Twist the strands together.



3 Attach wires to the receptacle. On a metal box, connect a ground wire from the receptacle to the box wall.



4 Center the GFCI receptacle in the box and screw it down. The cover must align properly with the receptacle's slots.

can't hurt most people) and shuts off current flow in a fraction of a second.

Adding GFCI protection

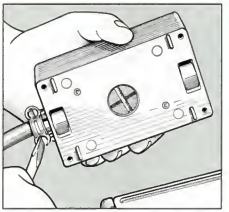
A GFCI can be added to a metal or plastic box. Metal exterior boxes come threaded for box connectors. Plastic boxes may be threaded, but many brands require an adapter. If you plan to use a plastic box, get the necessary plastic parts so the box can accept a standard clamp-type box connector.

Aside from the GFCI receptacle, you also need the following materials and tools: a 25-ft. 14/2 extension cord (14-gauge wire, 2 wires with ground), a weatherproof rectangular outdoor box that accepts dual receptacles, clamp-type box connectors, a combination wire cutter and stripper, locking pliers and a screwdriver.

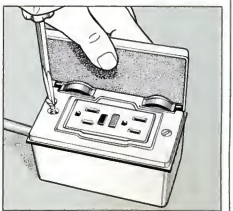
Making the cord

Begin by cutting off the cord's receptacle (Fig. 1). Strip about 6 in. of the outer cover from the cord's end, being careful not to cut the insulation on the inner conductors. Remove the insulation to expose a black, white and green wire. Strip off about ½ in. of insulation from the ends of each wire (Fig. 2).

Next, screw the box connector into the end of the box and tighten it with locking pliers. Loosen the clamp on the box connector and pass the end of the extension cord through the connector into the box. Pull a foot or so of the cord into the box.



5 Then, tighten the box-connector clamp screws to secure the cord to the box. Don't overtighten the clamp.



6 Place the rubber gasket on the box, and place the cover over the gasket. Fasten the cover with two screws.

The GFCI receptacle has either terminal screws (like a standard receptacle) or it has wire pigtails. In either case, you must connect the extension-cord wires to the terminals or the lead-out wires marked "Line." If the device is like the one pictured with screw terminals, wrap the black wire clockwise around the copper-color terminal screw. Tighten the screw, and check that there are no frayed strands to short out against the box.

Wrap the white wire around the silver screw in the same way (Fig. 3). Then connect the green ground wire to the green screw at the top of the device. If you use a metal box, you have to connect a ground wire to the box. To do this, run a short section of wire from the green screw on the GFCI receptacle to the ground screw inside the box. Use wire connectors to join the conductors to the GFCI receptacle if the receptacle is equipped with wire leads instead of terminal screws.

Now, pull the excess cord out of the box to make room for the GFCI receptacle. Secure the GFCI with the mounting screws provided (Fig. 4). Check that the protective outer cover of the cord is inside the box (none of the cord's bare or insulated conductors should be exposed outside the box), and tighten the screws on the box connector to clamp the cord in place (Fig. 5). Put the gasket in place and install the cover with the two screws provided (Fig. 6). **PM**

BOOK REVIEW

MOBILE HOME MAINTENANCE

● Good information on mobile homes is hard to come by, and this guide is one of the few books that address what mobile homeowners need to know. The book was produced by an insurance company that has spent 40 years writing policies for, and overseeing the repair of, mobile homes.

The book begins with an excellent exploded view of a mobile home. Each of the home's 46 components are numbered and clearly illustrated. The book concludes with a 3-page glossary that starts with "acoustical tile" and ends with "weatherstrip."

Between the beginning and the end are exterior and interior maintenance and repair projects, such as replacing siding. The best sections are the ones that deal with topics unique to mobile homes, such as installing foundation skirting and repairing the "belly board" (the asphalt-impregnated fiber board that lines the bottom of the mobile home). There is general construction information here, too. Some of this tends to be superficial, however. Given the otherwise fine quality of the book, this is nitpicking since general how-to information is widely available in other books and magazines.

The book costs $24.95 (plus $3 shipping) from Foremost Mobile Home Fix-It Guide, Dept. PM, P.O. Box 9082, Benton Harbor, MI 49022; or call (800) 524-3365. *—Roy Berendsohn*

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APPLIANCE CLINIC

BY STEVE TOTH, Contributing Editor

Replacing Glass-Top Elements

I have a Corning glass-top range model No. R-30DB purchased in 1973. The heating elements on top of the stove are starting to burn out. Two burners do not work now. Can I replace them?

OSCAR JOHNSON
BRAINTREE, MA

Contact Whitewood Limited, P.O. Box 451, Horseheads, NY 14845; (607) 739-2826. The small heating element is part No. 981134, and it costs about $45. The large heating element is part No. 981139, and it costs about $50.

To replace the elements, disconnect power to the range. Next, remove the screws holding the black plastic grille above the door. Remove the grille.

Now remove the two machine screws that hold the top assembly to the oven frame. Pull the range away from the wall, and remove the screws fastening the wire guard. Remove the guard. Then remove the vertical duct by pushing it up and pulling it out at the bottom.

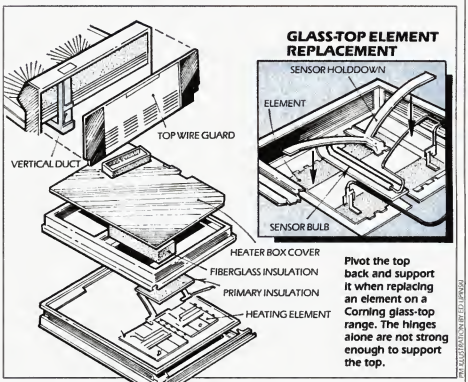
With someone to help you, lift up the stove top, and tip it back onto a chair or table. You must support the stove top because its hinges are not strong enough to carry the weight.

Next, remove the sheetmetal screws holding the heater-box cover to the heater box. Remove the fiberglass insulation that covers the primary insulating pads.

The primary insulation is a white material made of aluminosilicate that crumbles when you handle it. Remove the pads, vacuum up the debris and then wipe the area with a clean soft cloth to remove any remaining dust.

Now the heating elements are exposed and can be removed. To do this, remove the holddown spring and the wires connecting the element and the sensor bulb.

Vacuum the glass panel and the area surrounding the element. Position the new element on the glass panel and place the new primary insulation pad (the pad is included with a new element) on top of it.



Pivot the top back and support it when replacing an element on a Corning glass-top range. The hinges alone are not strong enough to support the top.

Next, position the sensor bulb in the element so that the bulb's flat surface is touching the glass panel.

Connect the wires to the new element and to the bulb. Reassemble the range. Test the newly installed elements.

Rusty Dishwasher

We have a Frigidaire automatic dishwasher model DWCDUT, serial No. 20FG9130. The bottom inside of the door has a peeled coating, which has exposed the door panel (now badly rusted). Are replacement panels available? If not, how can we fix the rusted door?

JIM McLEAN
PORTLAND, OR

A replacement inner door panel is no longer available for your 1971 model dishwasher. However, you can repair the door using an epoxy patch repair kit on the rusted area. The repair kit, Frigidaire part No. 5300185406, costs about $35. Although time-consuming, the repair is relatively easy to do.

Use a utility knife to cut away the thick but pliable plastic coating on the inside of the door panel. Start from where the coating is peeling on the badly rusted area, and keep cutting the coating back about ⅛ in. at a time until you get to clean metal. Remove as much of the rust as you can using a wire brush and sandpaper. Wipe away dust and debris, and then apply the patch according to the kit's instructions.

Wolf-Whistling Fridge

I have a Whirlpool side-by-side refrigerator model No. EWD19SKYR2, serial No. E34026125. Now and then, my refrigerator makes an annoying low "wolf whistle" when it runs. The noise comes from the freezer compartment. Is this something I can repair myself?

A. FRIEDRIKSON
ANTIOCH, CA

There is a 99% chance that the refrigerator's evaporator motor needs to be replaced.

To replace the motor, unplug the refrigerator, and then remove all food and shelving from the freezer section. Remove the Phillips-head screws around the evaporator cover (the cover at the rear of the freezer compartment).

Now you will see the evaporator-fan motor. Remove the two screws on the mounting bracket that hold the motor in position. Take the three wires off the motor and pull out the assembly.

Remove the old motor from the motor mounting bracket, and then remove the fan blade. Install these parts on the new motor. Reassemble the refrigerator.

The replacement fan motor is Whirlpool part No. 482469, and it costs about $35 at Whirlpool parts and service centers. PM

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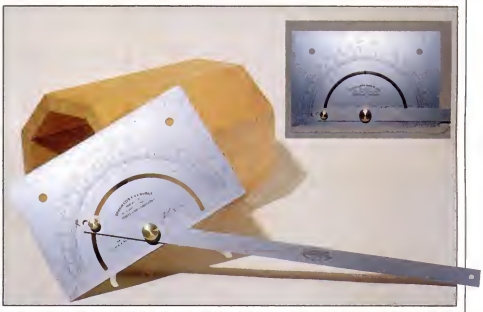
TOOL TEST

BRIDGE CITY PROTRACTOR

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO,
Contributing Editor



The BP-18 is a highly accurate protractor, square and shop guide. We found it to be a handy tool for setting angles on shop machines and sliding T-bevels.

● Sooner or later woodwork will take you beyond 45° or 90°. Most woodworkers, even professionals, have trouble using angles with precision, and that's where the Bridge City Tool Works BP-18 protractor comes in. Really, it's more than a protractor—it's also a square, a shop guide and a device to check that the cut stock matches the angle at which the machine was set.

In terms of tool history, the BP-18 is a more elaborate version of The L.S. Starret Co.'s venerable C-183 protractor, a tool that's still in production after 80 years.

Our shop test revealed the BP-18 to be highly accurate and usable. It's nicely machined from solid steel with a satin chrome-plated finish and photochemically etched markings.

The protractor face has three lines for angle reading. You can read 0° to 180° from left or right and 0° to 90° from left or right of center. Also, the tool's back is etched with handy shop data, like the metric/inch conversion factor (Photo 1).

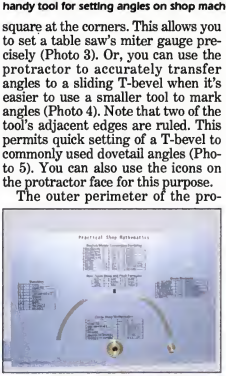
To use the tool, sweep its 18-in.-long indicator arm to an angle and lock the hairline cursor on the mark. You are assured of a precise reading because the indicator end is beveled so the hairline meets the angle line (Photo 2). Lock the hairline between the ½° markings to read angles down to ¼°. The tool's arm is locked firmly by two knurled brass knobs.

The opposite sides of the tool are ground parallel to each other and square at the corners. This allows you to set a table saw's miter gauge precisely (Photo 3). Or, you can use the protractor to accurately transfer angles to a sliding T-bevel when it's easier to use a smaller tool to mark angles (Photo 4). Note that two of the tool's adjacent edges are ruled. This permits quick setting of a T-bevel to commonly used dovetail angles (Photo 5). You can also use the icons on the protractor face for this purpose.

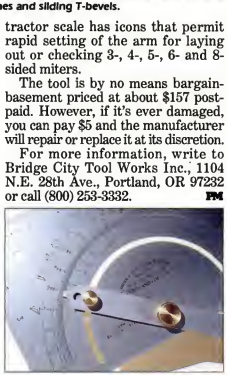
The outer perimeter of the protractor scale has icons that permit rapid setting of the arm for laying out or checking 3-, 4-, 5-, 6- and 8-sided miters.

The tool is by no means bargain-basement priced at about $157 postpaid. However, if it's ever damaged, you can pay $5 and the manufacturer will repair or replace it at its discretion.

For more information, write to Bridge City Tool Works Inc., 1104 N.E. 28th Ave., Portland, OR 97232 or call (800) 253-3332. PM



1 Etched into the protractor's back is a variety of handy shop information that relates to working with angles.



2 There is no discrepancy in setting the hairline on an angle, since the end of the indicator arm is beveled.

3 The sides of the protractor are ground square, allowing the tool to be used in setting up shop machinery.

4 You can set the desired angle on a sliding T-bevel using the protractor for cases where a smaller tool is handier.

5 Using the protractor's ruled edges or the face icons, you can quickly set the angle for hand-cutting dovetails.

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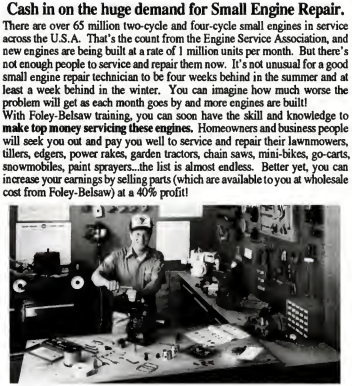

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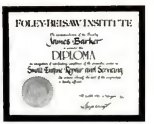

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Price, Utah

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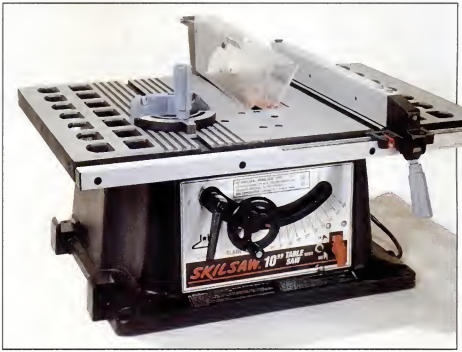
TOOL TEST

SKIL TABLE SAW

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO,
Contributing Editor



The 40-pound Skil Model 4300 benchtop table saw is designed for small shops and portability. It features a 10-in. blade, a 13-amp motor and a die-cast aluminum top.

● The idea behind all benchtop tools is to provide the features and versatility of full-size stationary machinery to folks with limited space and a modest bank account. And Skil's new entry, the Model 4300 benchtop table saw, does just that.

Featuring a 13-amp motor that drives a 10-in. blade at 4800 rpm, this saw has a capacity that compares with the larger floor models. It has a 17⅝ × 26⅝-in. die-cast aluminum table that provides a 12-in. rip capacity (maximum distance from the blade to the fence). And, the distance from the blade to the front edge of the table at a 1-in. blade height is 8½ in. Maximum depth of cut is 3 in. at 90° and 2½ in. at 45°.

Blade height is adjusted by the usual crankwheel mounted under the front of the table. Blade-angle adjustment, however, is less conventional. After unlocking the crankwheel, it's simply pushed by hand to set the desired blade angle (Photo 1).

Other features include a see-through blade guard with splitter and anti-kickback fingers, a circuit breaker for overload protection and a port for dust collection with a shop vacuum. The tool weighs about 40 pounds and has a plastic base.

We tested the saw with a series of typical ripping and crosscutting operations and found that it performed up to normal expectations. Ripping through 2½-in.-thick hardwood produced a very smooth sawn surface, attesting to blade and arbor stability (Photo 2). The saw easily handles 45° bevel cuts through nominal 2-in. lumber (Photo 3).

Rip fence alignment, a problem on many saws both small and large, is very accurate at any fence position. When locked in place, the fence self-adjusts so it's precisely parallel to the blade.

The blade insert, however, exposes a ¾-in.-wide gap around the blade. While this accommodates the blade as it's tilted from 90° to 45°, the space is too large for small work. To solve the problem, we made a custom plywood blade-hugging insert. After screwing the insert blank into place with the original screws, we slowly raised the rotating blade to cut the slot (Photo 4).

Optional accessories include a dado set and molding head with appropriate blade inserts, a table extension and a floor stand. The suggested retail price is about $250. Contact Skil Corp., 4300 W. Peterson Ave., Chicago, IL 60646. PM

1 A crankwheel controls blade height. To adjust angle, loosen locking lever and pivot the arbor assembly manually.

2 Blade guard with splitter and accurate fence make ripping safe and precise. The saw easily handles 2½-in. hardwood.

3 With a maximum capacity of 2½ in. when the blade is at 45°, bevel cutting nominal 2-in. lumber is no problem.

4 Standard blade insert (right) provides too large a gap around the blade for small work. A shopmade insert is the solution.

burago

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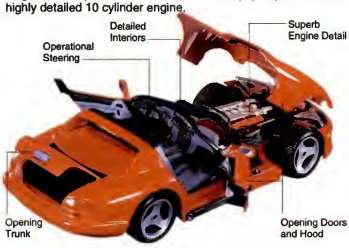
Burago's fully assembled die-cast miniatures are the new standard by which all die-cast miniatures will be judged. They are the finest, most accurately detailed automotive replicas available. Steering is operational and doors, hoods and trunks open and close. Metal body parts are finished with lead-free enamel. Exterior accents such as windshield wipers, door handles, realistic wheels and tire treads are standard equipment. Models are approximately 10" long and weigh 16-22 ounces.

Dodge Viper RT/10... the Star of the Collection
Created from Chrysler's prototype and the original blueprints, the 10" model is authentic in every detail. Red metal body is painted to exact Viper color specifications. Interior is complete with bucket seats, stick shift, foot pedals and dashboard instrumentation. Front tires move with a touch of the steering wheel, hinged doors open and close, and the hood pops up to reveal a highly detailed 10 cylinder engine.



1991 Bugatti EB 110

1987 Ferrari F40

1957 Chevrolet Corvette

1961 Porsche Cabriolet

1990 Lamborghini Diablo

1961 Jaguar "E" Cabriolet

Send $1.00 for a color brochure showing Burago's full line of 1:18 scale die-cast metal models (36 in all), plus a list of retailers nationwide.

BURAGO BROCHURE
Dept. PMC3, PO Box 1000, Mt. Pocono Industrial Park, Tobyhanna, PA 18466

__ **Yes!** I want more information on Burago die-cast models! $1.00 is enclosed.

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City _____
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Available at better stores everywhere.

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HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

Chimney-Top Damper

Our home, built in 1924, has a brick fireplace which has a lever-operated damper. The damper is jammed open. Can you advise us on how to fix this?

ALBERT SOBIEWSKI
FRAMINGHAM, MA

A good solution to your problem is to install a chimney-top damper. This spring-loaded damper is mounted over the flue opening at the top of the chimney. The device has a stainless-steel wire that runs from the damper down the flue into the opening of the fireplace. A pull chain and handle are attached to the wire with a setscrew and clamp.

To close the damper, a person pulls on the wire and fastens the pull chain to a bracket at the top of the fireplace. To open the damper, release the tension on the wire.

I've seen hundreds of these dampers during my inspections, and they are effective.

These dampers cost from $110 to $150, and if you have it professionally installed, it costs about $225 to $250.

One maker of chimney-top dampers is: Lymance International, P.O. Box 505, Jeffersonville, IN 47131.

Squeaky Floors

I have a problem with floors that squeak. I was wondering if you could give me some solutions.

GLEN LAURENSEN
VERMILLION, SD

The squeaks are usually caused by the floorboard edges (finish floor, underlayment or subfloor) rubbing.

Whether you have oak strip, vinyl or carpeted floors, the best solution is to get under the floor, from rooms below or the basement, then drive screws through the subfloor. The idea is to pull the layers of subfloor against each other or, in the case of oak strip flooring, to pull the finished floor against the subfloor.

If you can't get to the floor framing, you can do the following:

With carpeted floors, drive 2½-in. finish nails through the carpet and underlayment and into the floor joists. Locating the joists may be difficult, but it can be done by trial and error.

With hardwood floors, the Oak Flooring Institute recommends you first try a lubricant to eliminate the squeak. Squeeze a liberal amount of liquid wax, talcum powder or powdered graphite between adjacent boards where the noise occurs.

If that doesn't work, drive triangular glazier points between the floor strips, and then putty over the points. Or, bore pilot holes through the flooring, and then drive 2-in.-long nails through it and into the floor joists. Set the nailheads, and then putty over them.

Tape-Measure Repair

I have a 12-ft. Lufkin measuring tape on which the return spring has broken, and I have been unable to repair it. A local hardware store told me it is not repairable. Is this true?

HAMID A. BHATTI
HARRISBURG, PA

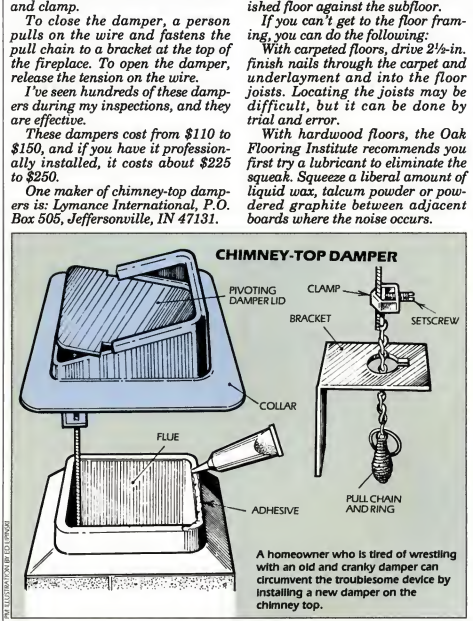
I spoke with the people at Lufkin Tapes, and they said that if the spring is broken, they will repair the tape measure at no charge (one tape per person limit). Send the tape measure to: Lufkin Tapes, Repair Dept., Lufkin Rd., Apex, NC 27502. Include your name, address and phone number.

Household Products Disposal

The next time you clean out the garage, you may be tempted to toss those half-empty paint cans in the trash and just dump the old pesticide on the ground outside. This solves your problem, but it causes environmental problems. The paint might spill en route to its burial in the local landfill, or it might find its way into the ground water once buried. Pesticide is sure to wash into nearby streams, or it might poison wild or domestic animals.

It's better to treat this trash with a little respect, and the Household Products Recycling and Disposal Council has a free brochure to show you how. Titled "Waste Not: Disposal Options For Consumer Products," the brochure has a list of safe disposal tips for household and automotive products.

Write to The Household Products Recycling and Disposal Council, 1201 Connecticut Ave. N.W., Suite 300, Washington, D.C. 20036. **PM**



A homeowner who is tired of wrestling with an old and cranky damper can circumvent the troublesome device by installing a new damper on the chimney top.

ILLUSTRATION BY JOE LEONARDI

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

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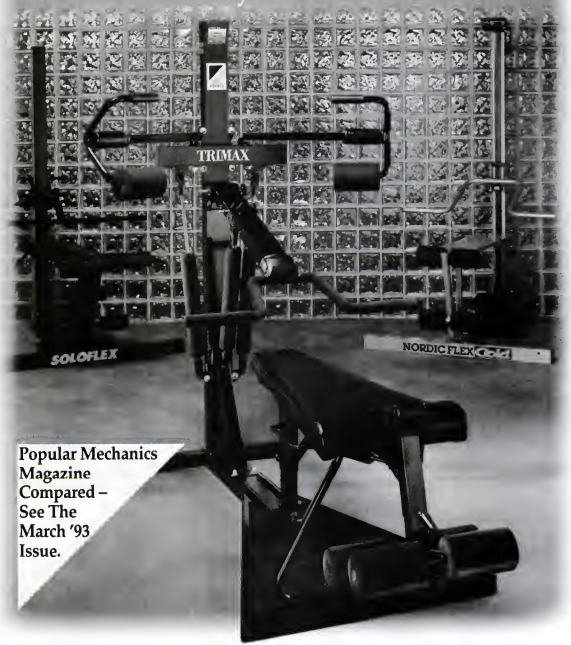

Popular Mechanics Magazine Compared – See The March '93 Issue.

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PM1293

NEW TOOLS

TOOL CITY

The best of the best from this year's National Hardware Show.

BY ROY BERENDSOHN, Assistant Home Improvement Editor

Ouch-Proof Protection

PM PHOTO BY RICHARD CANTOR/CD

It takes a heavy hammer to drive a large cold chisel, punch or brick chisel, so it's about time somebody devised a way to protect your hand while using these tools. These plastic hand guards are precisely molded so they fit very tightly to the hex shank of most striking tools. The guards are textured to provide a good grip. Not only do they protect your hand, they also absorb the shock of the hammer blow, reducing your fatigue while you work and further increasing the safety of using the tool. The hand guard costs about $7 at hardware stores and home centers (the cold chisel costs $8 to $10). For more information, write Mayhew Tools, 2 Sears St., Shelburne Falls, MA 01370.

Big John

Channellock's 414 pliers are so big they can compete with a pipe wrench. The 14-in.-long parrot-jaw plier is drop-forged steel, yet it's designed to be lighter, faster and more capable than an aluminum pipe wrench. Each of its grooves is spaced so that the jaws fit neatly around standard pipe sizes, and the jaws pivot on a rivet-like fastener, not a nut and bolt that can work loose. The tool has a stop to prevent the handles from closing accidentally, pinching your knuckles. The 414 costs about $20 at hardware stores, home centers and auto parts stores. For more information, write Channellock Inc., 1306 S. Main St., Meadville, PA 16335.

PM PHOTO BY RICHARD CANTOR/CD

A Big Step

Black & Decker says its new PowerShot staple gun is a big step forward in the design of this basic hand tool. After trying one, we agree that it offers significant improvements over older designs. It drives staples a good bit more smoothly, and requires less force from the user than traditional lever-operated models. B&D says it accomplishes this by positioning the driving mechanism directly below the user's hand. Just squeeze the gun's handle like you would with conventional staple guns. The tool has other nice features, like an easy-to-load staple chamber and a small window on the chamber that lets you see how many staples are left. The tool costs about $20 at hardware stores and home centers. For more information, write Black & Decker Corp., 701 E. Joppa Rd., Towson, MD 21286, or call (800) 762-6672.

More Than A Micrometer

Digital micrometers have been around for a while, but the Starrett 731 takes them beyond convenience and integrates them with computerized metalworking equipment and data storage systems. The tool transmits its readings to a computer disk via a handheld data collection device (the 742 Advanced data collection system, not shown). The tool has other useful features to machinists and toolmakers, such as a flashing OUT OF TOLERANCE display, an inch/millimeter converter and a HOLD READING retention feature. The 731 costs about $150 (without computer output capability, it costs about $109). For the nearest distributor, write the L.S. Starrett Co., 121 Crescent St., Athol, MA 01331-1915.

No Excuses

If you haven't bought Bosch power tools because they're not sold at your local home center, you have no more excuses. Bosch now has a tool line that's sold at home centers and hardware stores, the same places you find Skil tools. The two tool lines are sold in the same places because last fall Skil and Bosch formed S-B Power Tools.

The new Bosch tools are recognizable from their bicolor housings which are both Bosch blue and Skil gray. The tools rank below the industrial blue-color Bosch tools, but are equal in performance to the gray-color Skil professional tools.

The blue/gray Bosch tool line and the gray Skil tool line are not identical, however. For instance, included in the blue/gray line is the B7000 triangular detail sander (lower right corner of photo, about $100). A true orbital (not just vibrating) sander, it has a 3½-in. sanding pad that orbits at 13,000 rpm. Since the abrasive triangle will wear most heavily at the front corner, you can turn the pad to expose a fresh corner because the abrasive paper is held to the pad with a hook and loop (Velcro) system. Another nice feature is that you can attach the sander to a shop vacuum's hose to control flying dust (the other sanders have dust-control ports also).

Unique to the gray professional line (now known as the HD line for heavy duty) are two benchtop machines, a ½-hp bandsaw with a 6½-in. throat (about $330) and a 13-in. drill press powered by a ⅓-hp induction motor (about $270). Write S-B Power Tool Co., 4300 W. Peterson Ave., Chicago, IL 60646.

There's never been a better time to cut yourself a deal.

Now when you buy a Dremel 1671 or 1695 Scroll Saw in specially marked packages, you get your choice of two great offers from Dremel.

Choose our pattern offer and get 96 free scroll saw patterns from *Wood* magazine plus a special subscription offer – a $30 value. Or, for just $14.95, you can receive our scroll saw stand/leg set – a $58 value.

Whichever Dremel Scroll Saw you choose, the two-speed 1671 or the variable speed 1695, you'll get great features like a built-in blower to keep cutting surfaces clean, a large cast-aluminum table and heavy cast-iron base.

This is a limited time offer. So look for specially marked Dremel Scroll Saw packages at your local retailer now, and cut yourself a deal.

DREMEL®

Blade Swap

Stanley's new Contractor Grade hacksaw has a blade-tensioning system that lets you swap blades in seconds. To change a blade, first squeeze the lever at the back of the handle. Then, with your other hand, move up the button on the handle—and release your grip on the handle. The handle lever folds upward, releasing the blade. Insert a new blade and fold the handle lever back down until it clicks into place. The saw is part of Stanley's new Contractor Grade tool line (basically its professional line of tools that have been refined and improved). The saw costs about $20 to $30 at hardware stores and home centers. For more information, write Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

Flexible But Tough

Lenox bimetal sabre saw blades are made by electron-beam welding a flexible spring steel back to a cutting edge of cobalt high-speed steel. The cobalt steel is a very hard Rockwell C 65-69 (a good-quality wood chisel has a maximum hardness of C 60-62). The result is a flexible but hard blade, which, Lenox says, can cut through hard and soft woods, fiberglass and composites. It will even cut through a nail with no problem should you hit one accidentally. Also offered are metal- and ceramic-cutting bimetal blades. The blades range in cost from $2 to $4. They are sold at Lenox distributors. For more information, write American Saw & Mfg. Co., 301 Chestnut St., P.O. Box 504, East Longmeadow, MA 01028, or call (800)628-3030.

Funny Looking, But They Work

In case you're wondering, those funny-looking waffle pads on Hitachi's CJ65V2 allow you to clamp it in a vise blade side up for scroll sawing. This saw's nice features don't stop there, however. It has increased amperage over last year's model (5.1 amps versus 4.8 amps), a steel subbase for durability or an optional friction-reducing phenolic resin base to prevent scratching when sawing on easily marked surfaces. The company also beefed up the saw's blade support mechanism and made the saw available in a top-handled model. The variable-speed saw has three orbital-action settings, and it also cuts in a straight-line reciprocating mode. It costs about $330 at Hitachi tool dealers. For more information, write Hitachi, 3950 Steve Reynolds Blvd., Norcross, GA 30093.

Here's your Christmas Bonus.

Over $28 worth of additional sanding belts and discs free!

Now when you buy the Dremel 1731 combination Disc/Belt Sander in specially marked packages, you'll get a bonus of six extra belts and six extra discs included free.

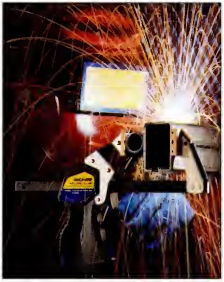
The Dremel 1731 Disc/Belt Sander is a tough, heavy-duty sander that's perfectly sized for the hobbyist. Its one-inch belt lets it get at places that a bigger sander can't. And the five-inch disc with miter guide offers even greater versatility.

Hurry, this is a limited time offer. So look for specially marked packages at your local retailer now. And pick up your Christmas bonus early.

DREMEL®

Good Vibrations

Freud took a laser and cut up its new saw blades so the blades, in turn, would cut quieter and without vibration. Those squiggly lines on the sides of the blade are the antivibration "reeds" cut with the laser. Freud claims that not only does the new blade run quieter, it also stays sharper longer by avoiding the dulling effects caused by vibration. Also, the blade uses Freud's carbide square-tooth design. These teeth are shorter and thicker than previous teeth, which, according to Freud, permits more sharpenings per blade and more accurate cuts between sharpening. The new antivibration blade comes in 40-, 60- and 80-tooth types in 10-in. dia. and costs about $130 to $135 at Freud distributors. For more information, write Freud, 218 Feld Ave., High Point, NC 27264.



Welder's Choice

The popular line of Quick-Grip bar clamps has been extended to include a 6-in. welder's clamp. Unlike most metalworking clamps that require two hands to operate, you can fasten and release the quick grip with one hand. The basic tool is the same as the woodworking clamp—a lightweight, glass-filled plastic body with a hardened steel bar. Unlike the woodworking version's plastic jaws, however, this clamp has carbon-steel jaws and copper-plated clamp pads. The pads are notched to facilitate clamping round bar and tubing. The tool costs about $33 at industrial supply and welding supply stores. For more information, write American Tool Co., 301 S. 13th St., Suite 600, Lincoln, NE 68508.

Power On/Power Off

The Power Stopper is a 50-ft., 16-gauge, 3-conductor extension cord designed to extend convenience and safety as well as 13 amps of power. The cord has a small bulb (with a 30,000-hour lifespan) that lights the translucent plastic ends when it's plugged into an outlet—notifying you that the cord has power. It also has a resetable built-in circuit breaker that cuts off power to the tool and protects the cord from overloads. The cord costs about $25.

Also available is the Quick Check, a lighted cord minus the circuit breaker. It's a heavier, 15-amp cord and it comes in 35-ft. and 75-ft. lengths (about $16 and $25, respectively). All three cords are sold at hardware stores and home centers. Write to Pacific Electricord Co., 747 W. Redondo Beach Blvd., P.O. Box 10, Gardena, CA 90247.

PHOTO COURTESY OF PACIFICELECTRICORD

Something For Everyone

Black & Decker seems to have a power tool for every level of use, but if you still feel the company hasn't offered you just the right tool at just the right price, maybe its new Quantum tools will fill the bill.

Sold at hardware stores and home centers, the Quantum line is designed for ambitious do-it-yourselfers who want to step up from even the best grade of homeowner-quality tools. Compared to homeowner tools, the line has improved airflow and added heavier bearing structures and heftier switches and gears.

Still, the Quantum tools are not quite as heavily constructed as Black & Decker's Industrial/DeWalt line. Also, homeowners, Black & Decker says, have different priorities from professional power-tool users. For instance, homeowners are more likely to want dust-control capability, so the feature is present on every woodworking tool in the line.

To identify just a few tools in the line, there is a 7¼-in. circular saw (about $80 to $90), a 2-speed heat gun (about $70) and a sabre saw with orbital action (about $80 to 90).

For more information on Quantum, write Black & Decker, 701 E. Joppa Rd., TW397, Towson, MD 21286.

Work Like A Horse

The Roughneck Portable Workcenter is more than a plastic sawhorse—with a 300-pound capacity and tool storage, it's more like a workbench. Its features include a V-groove for cutting pipe and dowel, through-the-leg slots for clamping and a hideaway storage compartment in the top that's designed for drill bits, measuring tools and pencils. Other molded-in appurtenances allow you to hang squares and power cords off the Workcenter. It costs about $30 at hardware stores and home centers. Write Rubbermaid Inc., 1147 Akron Rd., Wooster, OH 44691-6000.

Razor Sharp

Most knife-sharpening systems put an edge on a knife, but they won't get an edge razor sharp. Norton's Angle-Rite, however, is designed to let you control the level of sharpness you want. The system uses three pairs of sharpening stones: A coarse-grit Crystolon stone for fast metal removal, a medium-grit India stone for general sharpening a fine-grit natural Arkansas stone to polish the edge and make it razor sharp. Draw a knife, scissors or even a chisel against the angled face of the stone to sharpen it. The system costs about $45 at hardware stores and home centers. For more information, write Norton Co., Consumer Products Division, P.O. Box 15008, Worcester, MA 01615-0008.

Some tool manufacturers offer you a band saw, a scroll saw, a bench saw, a drill press–and call it a complete line. But at Delta, we realize that any one saw or drill press might not be right for everyone. Which is why we make seven different drill presses, five scroll saws, four table saws, two bench saws–well, you get the idea. Fact is, you can never have too much of a good thing.

Case in point is our new 12" band saw. It's built to fit nicely between our bench models and our bigger saws. And it's built with the same heft and precision you'll find in our professional tools. Yet it's priced to fit comfortably into your shop.

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HOME&SHOP JOURNAL

Not The Same Old Grind

If you regularly grind chisels and plane irons then you know that the standard grinder toolrest is inadequate, and that's where this toolrest comes in. It fits 6-in.- and 8-in.-dia. grinder wheels. To use it, pivot the 4-in.-wide grinding table up to the wheel, and lock it in place with spring-loaded handles. You can fold down the table if you want to grind freehand. The table fits around wheels up to 1 in. wide, and it's slotted to accommodate sliding toolrests. The toolrest costs about $35. For more information, write Veritas Tools, 12 E. River St., Ogdensburg, NY 13669.

Torch It

If you've got a big plumbing job ahead, this might interest you: a quick-disconnect air/acetylene torch handle and pushbutton piezoelectric ignition. At full flame, the burn tip stays cool, so you can turn off the torch and lay it down without starting a fire. This saves acetylene and extends the tip life by eliminating corrosive deposits caused by burning at low flame. The SureFire costs from $40 to $50, depending on size (a torch kit, shown, with a handle and tip, 12 ft. of hose and a brass regulator costs $150 to $180). It is sold at plumbing and industrial supply houses and at home centers. Write SureFire, 1 Bernzomatic Dr., Medina, NY 14103, or call (800) 654-9011.

A Change For The Better

Spindle sanders are generally not benchtop tools, but this machine changes that. Weighing only 29 pounds, it sits on your benchtop and sands 2000 ⅝-in.-long strokes per minute. The machine comes with ½-in.- and 1-in.-dia. neoprene rubber drums. Other drums are available, ranging from $6 to $25 each and in multidrum sets up to $43. Sanding sleeves are also available individually and in kits with prices ranging from $7 to $13. The sander has storage for extra drums and throat plates. The OSS450 costs about $200 at hardware stores and home centers. For more information, write Ryobi America Corp., P.O. Box 1207, Anderson, SC 29622, or call (800) 525-2579.

Snap To It

Changing a blade is a snap, literally, on the new AEG Fixtex jigsaws. To change a blade, just snap up the lever on the front of the saw, and the loosened blade falls out. Insert the new blade, and move back the lever. The saws also have 4-position orbital action, ceramic blade guides, a roller blade backup and electronic-feedback speed control. They are available in a top handle configuration or a barrel grip (both are about $305). The tools are sold by AEG/Chicago Pneumatic tool dealers. For more information, contact Chicago Pneumatic Electric Tools Division, 2220 Bleecker St., Utica, NY 13501, or call (800) 243-0870. **PM**

Why settle for some 2-bit power tool?

The Dremel Moto-Tool is the compact, high-speed rotary tool that's extremely versatile. With speeds from 5,000 to 30,000 rpm and more than 150 specially designed bits, it'll carve wood, shape plastic, grind metal, polish delicate silver, or handle most any job. Look for our book ***175 + USES*** in specially marked Moto-Tool packages where power tools are sold. Or write: Dremel, Dept. PM, P.O. Box 1468, Racine, WI 53406-1468 for a free copy.

DREMEL® MOTO-TOOL®

DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor

Taurus, 1996

● Ford plans a major restyling of its Taurus line in two years. The top-selling midsize sedan will feature new sheetmetal and a revised engine lineup. Exterior styling highlights a lower hoodline, sharper windshield angle and a 6-window greenhouse. Prototypes of the new car hint that styling changes will not be extreme, but the new car will present a departure from today's Taurus. A 4-door sedan and a station wagon will continue as body choices. This photo of a prototype shows unusual boxes around the door handles. The design is probably a temporary fix that will not be seen on the production cars. Some observers suggest that the boxes extend out to the new surface of the doors, and were late changes in the development program made to adjust to stronger side-impact protection.

Called the Mondeo overseas, Mystique and sister Contour have unique styling in U.S. trim.

Riviera, 1995

We showed you the first undisguised shot of the '95 Riv last month. Now, here's another view and more information. Buick has dropped the Riviera model for the 1994 model year. But it's back with a vengeance as a 1995 model, on sale in the spring of '94. The new model is a sister design to the Olds Aurora, but will be built as a 2-door coupe style instead of a 4-door sedan. Under the hood, buyers will have the option of GM's normally aspirated 3800 V6 (the base engine) or the brawny 225-hp supercharged edition. GM's world-class 4T80-E 4-speed automatic is the only transmission available. Major dimensions mimic those of the Aurora, including a 113.8-in. wheelbase, 62.5/62.6-in. front/rear track, and an overall length of about 205 in. Four-wheel disc brakes with ABS, dual airbags and traction control are included as standard equipment on the slick coupe, which will do battle with the world's best.

Continental will get welcome transplant of front-drive version of 4.6-liter modular V8.

Mercury Mystique, 1995

Ford designed a compact car for markets in both the U.S. and Europe.

Look for '95 Riviera in late spring.

This year it introduced the Mondeo overseas. Next year, Ford will introduce the Mercury Mystique and Ford Contour to U.S. buyers. Mystique is similar to the Mondeo in body styling. Look for unique taillights, front fascia, bumpers, hood and grille. One body style is planned, a 4-door sedan. Contour and Mystique will replace the Tempo and Topaz next year. Engines will be a standard 2.0-liter 16-valve Four and two optional 2.5-liter 24-valve V6s. Fuel economy is in the 30-mpg range for both 5-speed manual and 4-speed automatic transmissions.

Continental

Responding to the Cadillac Northstar challenge, Ford plans to put a V8 engine in the 1995 Lincoln Continental. The car will continue with its front-drive layout, but a 4.6-liter sohc V8 will replace the 3.8-liter V6 engine as the standard powerplant. The engine is the same one Ford uses in the Lincoln Town Car, the Ford Crown Vic and Thunderbird and the Mercury Cougar and Grand Marquis. The added power—210 horsepower

(Please turn to page 92)

$17,618*

The only views more breathtaking than the ones you'll see in the mirrors of a Jeep Cherokee Sport are the ones you'll see through its windshield.

That's because Cherokee Sport is engineered to take you far beyond the usual sights. With a 190 horsepower 4.0 litre engine, Quadra-Link* front suspension, and shift-on-the-fly four-wheel drive. All at a price that won't take your breath away.

For more information on Jeep Cherokee Sport, please call 1-800-JEEP-EAGLE. It will definitely give you something to reflect on.

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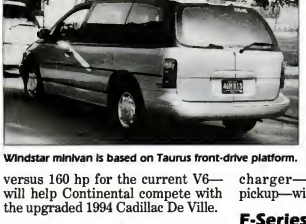
Jeep is a registered trademark of Chrysler Corporation.

 (Continued from page 90)



Windstar minivan is based on Taurus front-drive platform.

versus 160 hp for the current V6—will help Continental compete with the upgraded 1994 Cadillac De Ville.

1995 Ford Windstar

Look out Chrysler, here comes Ford's Sunday punch. And it's aimed right at your minivan section. Ford will officially unveil this new van—Windstar—as a 1995 model in mid-1994. Windstar will offer front-wheel drive and a lower floor than the Aerostar. Its overall size will be larger than the standard Chrysler minivan—about the same size as the Aerostar. Under the hood will be a complete Taurus drivetrain. That includes V6 engines up to 3.8-liter displacement and a 4-speed automatic transmission. Airbags for both the front passenger and driver will be standard, while built-in child safety seats for the rear will be options.

Ford borrows Dodge styling for '95 F-trucks.

Mazda Cougar?

Yes, it's being planned. Ford is looking at a way to build the Cougar on a Mazda platform, and design the sporty coupe apart from Thunderbird. Under this proposal—which sounds loonier the further it goes—Thunderbird would also switch to front drive, and be built along with a low-price front-drive Jaguar sedan at an Ohio assembly plant. Benefits include a boost to Mazda (which Ford partly owns) and the introduction of a low-cost Jaguar (which Ford also owns). All the plans are a possibility for the 1998 model year.

Dodge Suburban

It's not in the works, but Chrysler officials say they'd like to have a Suburban-type vehicle that would be built off the new Ram pickup body. But the market for such a vehicle is not large enough to pay off for Chrysler. Chevrolet and GMC sell about 80,000 Suburbans a year now. With Ford expected to introduce a Suburban-type vehicle in a couple of years, the market will be split. That leaves little room for a profitable third name—like a Ram derivative. However, look for Chrysler to give the green light to a new Ramcharger—one based on the Ram pickup—within two years.

F-Series, 1995

Ford will take a cue from Dodge's macho Ram pickup styling in designing its new F-series line. The 1995 Ford full-size truck will feature an aggressive grille design, along with front fenders that blend back into the doors. The F-series will also have dual airbags. Chrysler officials believe that the styling of the Ram pickup—lower fenders, thrusting grille, larger cab—will be imitated by Ford and Chevrolet. First sightings of Ford's 1995 prototypes confirm that estimate.

Electric Trick?

That's the way the electric car is shaping up for California. Beginning in 1998, at least 2% of the cars sold in that state must emit "zero emissions." Basically, that means electric cars. Today, you can't get the automakers to admit that they will have a car to fill that bill. Selling electrics in those numbers—2% means at least 20,000 cars each year—is not thought to be possible. Automakers are hoping that hybrids—vehicles that use a combination of batteries and some other power source—will be acceptable, even though they are not zero-emission vehicles.

Exporter Extraordinaire

What distinction does Honda hold in the U.S. manufacturing community? Among U.S. car builders, Honda exports the greatest number of cars overseas. Yes, more than Ford, Chrysler or GM. From its Ohio assembly plants, Honda exported 75,000 cars to overseas buyers last year, 40,000 Accords and 35,000 Civics. Win a bet on this one. PM

 (Continued from page 39)

Among other things, the space-consuming magnetic focusing electrodes found in the funnel of an electron gun are replaced by the flat, electrostatic deflection plates. Ditto for the shadow-mask. It's not necessary, because there's no spray-shooting beam that might not hit its target. In any case, the use of discrete cathode-phosphor cells and specific electrostatic deflectors means that the beams shoot point-blank at their target phosphors.

The result is clear, sharp images at every point on the screen—not just the middle where an electron gun is most accurate.

Here it helps to think of a flashlight beam. When focused straight-ahead at a surface, the lighted spot is round. When aimed from an angle, an oval pattern appears on the surface.

With no shadow-mask that can warp from the heat of electron bombardment and misdirect the beams, there won't be any blooming distortion in the corners—blooming being a green or purple coloration.

Also, since there's no need for a mask or the opaque grout between color phosphors, you won't see that grid-like mosaic-tile pattern in your picture. Images are smoother, more film-like.

Something this good can't be all good, and Flat Vision has its drawbacks, too.

For one thing, this 13-incher eats up 85 watts—some 15 to 20 watts more than conventional CRTs of the same size. This includes the tuner and amplifiers for its 4-speaker stereo. Matsushita says power consumption will come down as the design is refined—and we've been around electronics long enough to know that this is likely.

Additionally, this television might be flat, but you'll need a fat wallet to buy one.

At today's exchange rate, the price is $2880 in Japan. Not to mention the usual 36% import tariff added to the U.S. sticker if U.S. Customs classifies it as a conventional CRT rather than a unique product (for the record, there's no tariff on LCDs as there's no U.S. industry to protect).

Matsushita says that price will drop dramatically once full-scale production begins and economies of scale kick in (only 1000 will be made over the next year). Over the short-term, that "volume-efficiency" savings will be accounted for by marketing Flat Vision for computer monitors, where price is less of an objection than in the light-and-play TV business. Slim TV/VCR combinations and midsize wall-hanging TVs are other applications. PM

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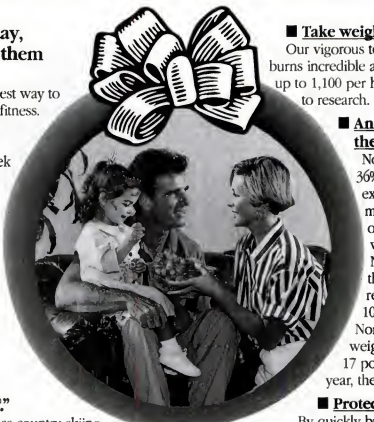

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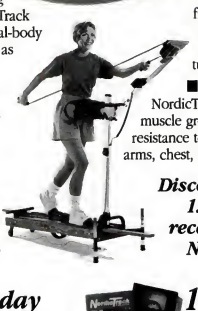

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RUSSIA'S CROWN JOULES

BY GREGORY T. POPE, Contributing Editor

● Only two people can grant you access to Arzamas-16: Russia's Minister of Atomic Energy or Boris Yeltsin himself. After all, this doubly fenced secret city, nestled in picturesque woodlands about 180 miles east of Moscow, remains Russia's primary nuclear-weapons design laboratory.

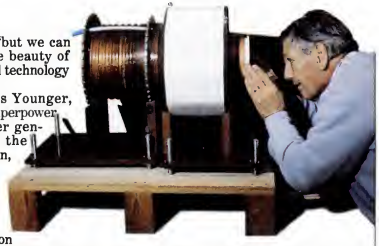
So it speaks to the new ease between Russia and America that top physicists from Arzamas-16 are collaborating, for the first time ever, with their counterparts from Los Alamos National Laboratory. And it's a tribute to Arzamas-16's long-shrouded scientific knowhow that the Americans are raving about the Russian machine at the focus of the joint research.

The device is called a disc electromagnetic generator, and it simply blows away anything assembled in a Western laboratory. What the generator does is dizzying physics: It spits out—for a millionth of a second—more wattage than the electrical generating capacity of the entire planet. Physicists measure this kind of pulse in megajoules, energy units usually reserved for nuclear explosions.

"We couldn't duplicate it," admits Stephen Younger, program director for high-energy-density physics at Los Alamos, "but we can appreciate the beauty of the science and technology they're doing."

Russia, says Younger, has been the superpower of super-power generators since the '50s. Back then, Russian physicist Andrei Sakharov—Nobel Prize winner, dissident and patron saint of Arzamas-16—seized on the idea of using high explosives to compress and intensify a magnetic field. Initially, he envisioned a pure fusion weapon. The magnetic field would lend thermal insulation to a hydrogen plasma, while the plasma was heated to trigger a thermonuclear reaction.

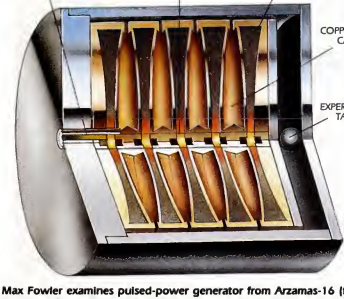
Sakharov assigned a team of physicists to work on it, and although the weapon never came to be, he became intrigued with the thought of harnessing ultrahigh magnetic fields for physics research. "And with such a concentration of talent," says Younger, "they were able to develop the technology to a superb state of perfection."

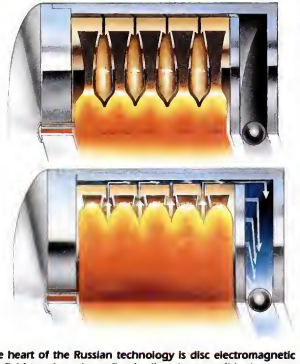


LOS ALAMOS PHOTO

During the 1960s and '70s, Los Alamos pursued its own explosively driven pulsed-power generator, using a technique pioneered by shock physicist Max Fowler. Today, a third-generation device, dubbed Procyon, is in operation.

Inside Procyon, an electrical coil spirals about a metal cylinder packed with explosives. A bank of capacitors sends a current around the coil, creating a magnetic field between the cylinder and the coil. Then the explosives go off. The cylinder swells out suddenly and the magnetic field is compressed, greatly amplifying the current, which then slams into some experimental target. Among other





PM ILLUSTRATIONS BY PAUL DRAWE

Max Fowler examines pulsed-power generator from Arzamas-16 (top). At the heart of the Russian technology is disc electromagnetic generator (above). Explosives go off to squash cavities, compressing magnetic field to release huge flux (red) and current (blue).

applications, Procyon is used to simulate some of the conditions that occur in a nuclear explosion.

But when Fowler, Younger and colleagues Bob Reinovsky and Irv Lindemuth visited Arzamas-16 in June 1992, they realized how far ahead the Russians had forged. In the Russian apparatus, the coil-based generator serves merely as a preamplifier for the main disc generator.

The current from the pre-amplifier—a good 6 million amps—sets up a potent magnetic field in a series of copper-lined cavities separated by discs of explosives. When the discs detonate, the cavities collapse, again compressing the magnetic field to pump out a monster current carrying up to 200 million amps.

Megajoule megajolts spark all sorts of possibilities for high-energy-density physics. Last September, in Russia, the Los Alamos and Arzamas-16 physicists conducted experiments that probed the output of the Russian generator with precision American diagnostic equipment.

Meanwhile, four smaller generators recently shipped to Los Alamos will inflict ultrahigh magnetic fields on the new high-temperature superconducting materials. The reason: Magnetic fields tend to deform the very structure of matter, bending the orbits of electrons that circle atomic nuclei. The Los Alamos physicists aim to distort the superconductor's atomic structure until the material no longer carries current without resistance. These magnetic-field experiments will allow the researchers to test various theories that account for the still-mysterious mechanisms of superconducting.

Next year, the physicists plan to replicate the conditions found at the cores of gas-giant planets, such as Jupiter, using power pulses to compress a sample of hydrogen or helium.

Also targeted for investigation is Sahkarov's original fusion concept, which the Russians have continued to develop with an eye to power generation. This approach, known as magnetized-target fusion, combines aspects of the two fusion-power techniques pursued in the West. Like inertial-confinement fusion, magnetized-target fusion features a fuel pellet that is made to implode, crushing and heating itself to fusion conditions. The difference: In magnetized-target fusion, the fuel is already heated to form a plasma—and swaddled with a magnetic field to keep it hot—by the time it implodes.

Ironically, while the Russians have championed the concept, the closest anyone has come to fusion this way was at Sandia National Laboratories in 1979, when physicists directed electron beams at magnetized glass spheres full of deuterium-based plasma. The Russians have followed a different tack, using explosives to generate a powerful magnetic field, an approach that doesn't demand immense jolts of energy in the form of beams or heat. In addition, says Younger, "Not having to invest in mammoth machines, which you're then stuck with, is an advantage."

It's no secret that ultrahigh electromagnetic pulses have military applications as well, especially as a means to short out an adversary's electronics systems. The Los Alamos/Arzamas-16 collaboration, however, bears no such overtones.

Instead, it's designed to fuse scientific relations while defusing tensions. Unspoken, meanwhile, is the wish to keep Russia's weapons-design talent pool—somewhat idled by the Cold War's end—from drifting into unsavory employment elsewhere. If measured by the science that emerges, the joint venture between the two nuclear-weapons labs may prove as important as any pact between the two governments. **PM**

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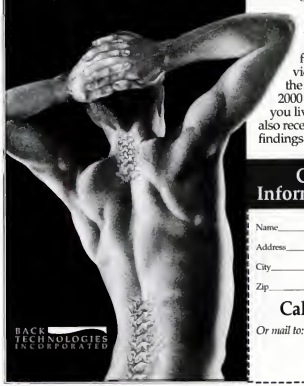

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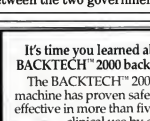

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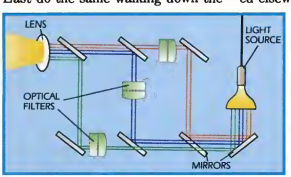
BERLIN DIARY: LASER TV AND OTHER ART OBJECTS

BY FRANK VIZARD, Electronics Editor

● The Wall has been down for a number of years now but Berlin is still a city where the East and the West parts are getting to know each other. Taxi drivers from the West routinely get lost when they cross over to the East, mostly because street names change frequently, depending on local political currents. West Berliners stroll down the Unter Den Linden, the East's tree-lined main boulevard, with wide eyes, rediscovering their own city. Those from the East do the same walking down the Kurfurstendamm in the West.



Schneider transmits a TV signal via a laser beam.

Berlin is also a city where the Eastern and Western ends of the electronics industry meet every two years at a show called Funkausstellung, an event that attracts about 450,000 visitors. Companies like Sony and Panasonic exhibit alongside European giants like Thomson and Philips. And while you'd expect major product introductions from the Europeans, even the Japanese use the show to break news. Sony, for example, distributed its new Snap! camcorder in Berlin. Listing for $1200, Snap! features a 3-in. color LCD display that works as a viewfinder. It's also very light—weighing just 1.4 pounds—and small—measuring less than 4 × 6 in. in size.

Sony's new lightweight Snap! camcorder.

As a European showcase, though, Funkausstellung is interesting because of its emphasis on design. European companies tend to bring an artistic touch to product design that's rarely emulated elsewhere. The Philips exhibit, in fact, was almost completely dedicated to a display of electronic art. Perhaps the most dramatic piece was a large work called Turtle by Nam June Paik of South Korea. The turtle is actually 166 TV monitors displaying a variety of images, and is meant to be a commentary on how television has replaced the tortoise of the ancient Chinese as a meditation device. The Chinese used to divine the future—apparently with limited success—by meditating upon the cracks in a tortoise's shell. For modern man, the television has a similar function.

A TV turtle for meditating by.

As applied to actual products, the artistic touch can be seen in products like a compact-disc player called the Oyster—the lid opens like a shell to reveal the musical pearl inside. Here's something for playing old Blue Oyster Cult tunes.

Hartmann Design, meanwhile, offers an array of differently designed speakers, one of which hangs suspended in midair like a giant teardrop.

A CD player for the Blue Oyster Cult.

Design even enters into the thinking of larger companies in ways not commonly seen in the United States. Philips, for instance, showed a 21-in. TV called Sensuval with a flat, round glass covering the actual rectangular screen.

Of course, there was substance and not just style on display. Technically, the most interesting development came from Schneider, a German television maker.

Schneider demonstrated a prototype of a laser TV projection system it says is three years away. The red, green and blue picture elements are actually transmitted to the screen via a laser beam. The laser beam passes through an array of mirrors and optical filters to produce the large palette of colors required for picture reproduction.

Schneider says a laser TV system has advantages over tube-style TVs, particularly if you want a flat picture.

(Please turn to page 99)

 (Continued from page 96)

With electron-gun tube technology, there is a risk of distortion at the edges of the screen due to the way the electron beams hit the surface. As picture tubes get wider, they also tend to get deeper as part of the anti-distortion effort. Tubes also tend to get cumbersomely large after awhile, making the whole television too large and heavy for most living rooms.

The precision of the laser beam and its ability to project on any size flat surface makes the issue moot, says Schneider. Distortion and color faults are history. Picture brightness and contrast are enhanced. And while the picture seen at the exhibit wasn't perfect, the technology did work and doubtlessly can be improved upon.

Schneider also notes that laser TV is environmentally friendly in that it saves energy and doesn't require the use of hazardous materials. This issue is particularly important in Germany, which this year adopted very stringent environmental laws. TV makers, for example, are required to accept back for recycling all the TVs they sell. Schneider and other European electronics manufacturers are making products that are totally recyclable as a result.

Two other items of note: Amstrad of England bowed a personal digital assistant with software from Texas Instruments that makes it very different from Apple's Newton (see "Personal Communicators," page 47).

And Panasonic showed its Area Bank radios that are about the size of a credit card and are preprogrammed with 14 radio stations for 15 cities. Just push the button for the city you're visiting.

A Better VCR

Although much of the talk in video concerns future applications, such as digital processing and high-definition, there's still room for improvement in the analog technology now used in home VCRs and family camcorders. Panasonic recently did some tinkering with the ½-in. VHS format, and though it's hard to see what's under the hood, the results are visible on your TV screen.

Several VCRs and camcorders in the company's current line employ technology that until now has been an exclusive feature of professional and broadcast gear. It's the Dyn-Amorphous recording head, and its visible benefit is a clearer picture with richer color than you're used to seeing from home video.

In video recording, two or more heads on a rotating drum transfer video signals to the magnetic recording tape. The electrical voltage from the heads alters the magnetic field of the tape to create the recording. The process is reversed for playback: The heads detect the altered magnetic pattern on the tape, convert it to video frequencies and amplify it for viewing on TV.

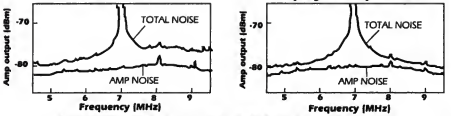
Usually, the video heads used in home gear are solid blocks of ferrite, an iron-base metal. But Panasonic's DynAmorphous heads have a ribbon-like arrangement of alloys, and contain no iron at all. Thin slices of alloys are laminated in a sandwich-like arrangement between nonmagnetic ceramic materials.

The purpose of Panasonic's non-ferrite construction is to impart a stronger signal to the magnetic tape by reducing electrical noise—specifically, something called contact noise.

Video signals are always accompanied by electrical noise but the amount, or signal-to-noise ratio, determines the clarity of the image. A picture with high levels of noise can look grainy or "snowy" with washed-out color. According to Panasonic, most noise comes from contact between the video heads and the tape. Heat and stress generated by regular ferrite heads cause fluctuations in the video signal—noise. This is amplified on its way to your TV, robbing clarity and dulling color.

Because of its ceramic components and amorphous, non-ferrite makeup, the DynAmorphous head improves the signal-to-noise ratio by a very visible 1.5 decibels—some 12% better than ferrite systems. A stronger video signal can be recorded on the tape in the first place, and less noise is picked up on playback. New noise-reduction circuits are applied too, to enhance sharpness and maintain saturated color.

—Stephen A. Booth



A less-noisy amorphous recording head yields a better VCR picture.

PM HOTLINES

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RUBICON RULES

BY JOE SKORUPA, Boating/Outdoors Editor

PM PHOTO BY DAVE RUSS

● On a plane to Denver a passenger notices I'm reading a 4x4 magazine. "I like 4-wheeling," he says, "but the trails in New Jersey aren't like the ones in that magazine, or like the great ones in the West, from what I hear."

We talked all the way to Denver, but I didn't have the heart to tell him that my ultimate destination was Reno, and from there I was headed to the Rubicon Trail, the mother of all 4x4 trails. I didn't tell him because I knew exactly how he felt. No matter where you are, there's always a trail you've heard is better.

For the past 10 years, no matter where I've been, be it the Great Divide in Colorado, the Four Corners in the desert Southwest or the red-rock monuments of Arizona—someone always says: "This is great, but have you been to the Rubicon Trail?"

So, when Goodyear invited me to drive the Rubicon this summer using its new Wrangler GS-A on/off-highway tires, I jumped at the chance.

Located high in the Sierra Mountains north of Yosemite National Park in California is a rustic village called Georgetown. It's just a couple of miles from Sutter's Mill, where gold was struck in 1848.

But gold isn't Georgetown's claim to fame. The town is notable for being the starting point for the Jeep and Jeepers Jamborees (Goodyear is the official tire). These annual 4x4 events run from Georgetown to Lake Tahoe through a high-mountain meadow that's been attracting tourists for 100 years. The route, which was originally established after the Civil War as a link between Carson City, Nevada, and Sacramento, California, is known as the Rubicon Trail.

I was in a 3-Jeep contingent that included several Jamboree veterans. We departed at dawn to get a head start on the main convoy. After driving about an hour on blacktop and unpaved logging roads, we arrived at Wentworth Springs. From here, I began my lesson in the Rubicon Rules. They are as follows:

1. *Rocks are your friends.* The Rubicon Trail is basically a boulder field, so being on good terms with rocks is an act of self-defense. Scan the trail for big rocks, and then aim the wheels right for them. Make sure you hit them directly, and you'll be using them to your advantage. By driving over big rocks you'll raise your axle, transfer case and differential out of harm's way. Also, you won't get high centered or pinch the sidewalls of your tires.

2. *Slow never felt so exciting.* In a way, driving the Rubicon is a little like slow-motion racing. You're sweating bullets and putting everything you've got into nonstop maneuvering. You're touching the gas, pulsing the brakes, feathering the clutch, steering with precision, getting serious air with the wheels, and all the while you're going no faster than a turtle. It took us about 6 hours to drive from the trail head to Rubicon Springs, a distance of 9 miles. Basically, the drill is to shift into low-range 4wd, and let the Jeep walk in idle. If you have a manual transmission, stay off the clutch as much as possible. If you don't, you'll quickly burn it out.

3. *Jeep is the real thing.* You don't have to drive a Jeep in the Jeepers Jamboree, but you'll probably wish you did. Jeeps, especially CYs, CJ-5s and CJ-7s, are excellent rock creepers because of their tall suspensions and short wheelbases.

The only other vehicles allowed are Toyota Land Cruisers and Land Rovers. (All vehicles must have roll-bars.) The deciding factors are high ground clearance and raised body components.

Even if you are crazy enough to bring an unsuitable vehicle (and in the early years some people did), the Jamboree organizers won't let you use it. Pickup trucks would work, except for their long wheelbases and light rear ends.

My particular trip wasn't a Jeepers Jamboree, but a Jeep Jamboree, a distinction that means only Jeeps are allowed. All I saw were C-model Jeeps and a few old Scramblers, and they did just fine.

4. *Four-wheelers bond in strange ways.* They wear funny hats, for ex-

ample, and fly grand pianos into the woods by helicopter. Keep in mind that the purpose of a Jamboree isn't a macho challenge, the purpose is to have fun. And each person who attended the event did his or her best to pitch in, all 400 of them.

While some might complain about heading out into the great outdoors with a battalion-size contingent of 4-wheelers, the truth is that there are certain advantages to this. For example, the registration fee entitles you to eight cooked meals over two nights and three days. Plus, there's a cash bar (drinking alcohol is prohibited on the trail itself), an ice-cream stand, a poured-concrete dance floor and two country bands that play under the stars.

5. *Bring a super-soaker.* The Rubicon River runs through the campsite area and forms a series of swimming holes. However, since the campsite is located at an elevation of 6000 ft., the water is as cold as a frozen margarita. Still, that doesn't stop anyone from diving in. So, be sure to bring a bathing suit, a towel and a high-powered water weapon. Forewarned is fore armed.

6. *Be prepared for carnage.* Most serious 4-wheelers are careful drivers and good mechanics, but the Rubicon is the mother of all 4x4 trails. The least you can expect is a few small dents. Some of the easiest-to-fix carnage I encountered were flat tires, fouled air filters and broken spring shackles, spindles and wheel hubs. Other problems were a bit more difficult for field repairs, such as sheered radiators, snapped tie rods and busted frames. For this kind of damage, a complete garage with nine mechanics is set up at camp to make sure every vehicle gets out on its own power.

7. *Everybody's doing it.* Who's the typical Rubicon Jamboree attendee? They're young couples and older couples, female friends and male buddies, families and kids, hikers and swimmers, stargazers and dancers, early risers and late revelers, gregarious carousers and independent-minded campers who go off quietly by themselves. The only common denominator is a love for the deep backcountry. The beauty of the Jamboree events, begun in 1953, is that they're extremely well organized and accessible to a wide cross section of people. To date, more than 25,000 vehicles and 82,000 people have enjoyed a Jamboree event. For more information, write Jeepers Jamboree, P.O. Box 1660, Georgetown, CA 95634.

8. *Tread Lightly.* The management of the Jeep and Jeepers Jamborees, notably organizer Mark Smith, strongly supports the Tread Lightly low-impact program. As part of its stewardship, the Jamboree management maintains the wild integrity of the Rubicon Trail by rigorously policing the trail for litter and land damage. Not only do the organizers give out litter bags to each vehicle, but they also collect the refuse at trail's end.

So, I've finally driven the country's most celebrated 4x4 trail. No flats. No dents. No breakdowns. However, as I was walking through the campsite one night, I overheard this conversation: "This is really great, but have you ever driven the slick-rock trail near Moab? It's spectacular and super tough." Some people are never satisfied. PM

The Ultimate Rubicon Trail Runner

●The goal of every Rubicon Trail driver is to get his or her vehicle to Lake Tahoe in one piece and with as few dents as possible. This can't be done with a stock 4x4, even a stock Jeep. Serious Rubicon drivers virtually rebuild their vehicles from the ground up. One such vehicle is owned by Kelly and Christine Swanson, of Santa Clara, California. Their vehicle is a Jeep CJ-7 that took two years to whip into shape. Here's how they did it.

The first thing was to buy a used Jeep that was primarily used on the street as opposed to off-road. The Swanson's model is an '84 CJ-7 with a 258cc inline Six engine and a manual transmission. A limited-slip differential was added to the front and a locking differential to the rear. The Swansons were tempted to drop in a Ford T18 transmission, but since their model was already a manual they decided to simply change the gearing in the differential to provide a super-low First gear.

Thirty-three-inch tires were added. Aftermarket wheel hubs and axles were installed for strength. To improve structural integrity, steel plates and bars were welded to the frame. Then, the frame was raised 2½ in. by a lifting suspension and 1½ in. by the addition of beefier shackles and shackle mounts. Heavy-duty shocks were installed. To provide undercarriage protection, skid plates were added for the U bolts and the transfer case. Angle iron was added for the rocker panels.

Stock bumpers were replaced by tube-steel bars. On the front, a winch mount was added. Tow hooks were bolted to the front and rear bumper mounts, and an 8000-pound capacity winch was installed. What else? The following: a reusable air filter, diamond-plate rear corners, a heavy-duty steering stabilizer, a full roll cage, a 4-point safety harness and too many others to list. How much did it all cost? Don't ask. —*J.S.*

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MOTORSPORTS

BATTLE FOR THE BRONZE

BY JEREMY SHAW

PM PHOTO BY JONAH DUCKSTEINE

● As our December issue went to press, the gold and silver positions in the '93 PPG IndyCar World Series had been settled. But with one race left on the schedule, Team PM's Raul Boesel was still in contention for third place in the final standings.

Britain's Nigel Mansell clinched the PPG Cup by winning brilliantly at Nazareth Speedway, in Pennsylvania. It was his fourth straight oval-track victory—amazing for a driver who hadn't so much as *seen* an oval track before this season.

PM PHOTO BY STEVE SWOPE

Jimmy Vasser drove well in 1-year-old Lola/Ford chassis.

While Mansell was busy locking up the title, '93 Indy 500 champ Emerson Fittipaldi clinched second, leaving third place a battle among Boesel, Canadian-flash Paul Tracy and '92 season champion Bobby Rahal.

Although he continued to be one of the very few who could compete with the leading Penske and Newman-Haas teams, small mishaps kept Boesel from taking control of third place in the standings. He ran consistently in the top five around Vancouver's demanding street circuit, keeping his Dick Simon Duracell/Mobil 1/Sadia Lola/Ford-Cosworth XB in contention until the second pitstop.

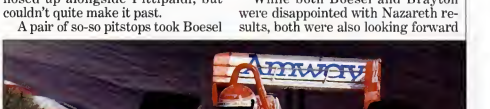
"We killed the engine," Boesel admits. "My car was hanging in there. We had a slight problem with the brakes, but the car was very good in Turn 1. That's where I made most of my time." The lengthy stop relegated Boesel to a ninth-place finish.

Boesel's teammate Jimmy Vasser also drove well in Jim Hayhoe's Kodalux/STP Lola/Ford, keeping his year-old car in the top 10 during most of the early going.

It was an awful weekend for Scott Brayton, the third member of Team PM. Qualifying problems saw him only 19th on the grid, and the race lasted only to the first turn, where the Amway/Northwest Airlines Lola/Ford was involved in a multicar pileup.

Scenic Mid-Ohio was next for the team, and once again Boesel was in contention, this time for the early lead of the race. Several times he nosed up alongside Fittipaldi, but couldn't quite make it past.

A pair of so-so pitstops took Boesel out of contention for the win, and he eventually came home fourth, a scant half-second out of third.



PM PHOTO BY STEVE SWOPE

After a dismal day at Vancouver, Scott Brayton finished in the top 10 at Mid-Ohio.

Vasser, meanwhile, posted another fine effort, qualifying ninth and running as high as fifth before a stop-and-go penalty for excessive pit-lane speed dropped him to 10th—two places behind Brayton. Brayton, for his part, had put on a very steady run to his eighth-place finish after starting 18th.

Pinched funding kept Vasser out of the Nazareth round, and rain washed out qualifying for everyone else. Accordingly, grid positions were assigned on a basis of championship points, and Boesel started third. He was quickest in the Sunday morning warmup, but in the race his car's handling quickly deteriorated and he fell back for a ninth-place finish.

"It was loose," he said later. "Big time. We made some changes and on the last set of tires it was better. But it was loose all day."

Brayton wasn't happy with his car's handling, either. He ran mid-pack and finished 14th.

While both Boesel and Brayton were disappointed with Nazareth results, both were also looking forward to the Laguna Seca finale. Boesel, in particular, had his eye on the final points standings—the driver finishing third will take home a check for $300,000 from PPG Industries. **PM**

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FIRST BRANDS

STP DRIVE A BETTER CAR

MOTORSPORTS

PRIZE PRELUDE

BY TONY SWAN, Automotive Editor

PM PHOTO BY MARK WEBER

● It doesn't seem long ago that we launched our 1993 Sports Car Club of America racing campaign, on a rainy day at Willow Springs, California. Nevertheless, the season has sped to the finish line, and as this is written, we're getting ready for the national championship runoffs at Road Atlanta.

Whatever the result may be at Road Atlanta, though, 1993 will go into the PM record books as our best club racing season ever. And as much as we'd like to attribute our success to careful maintenance, canny tire-pressure settings and superior driving, the truth is the car—a '93 Honda Prelude VTEC—had something to do with it. Okay, it had a lot to do with it.

From our first hands-on encounter, we thought the Prelude VTEC would be a contender. This application of Honda's versatile VTEC (for variable-valve timing and lift electronic control) technology transforms a mild-mannered 2.2-liter dohc 16-valve Four into a veritable tiger. The transformation occurs at about 5200 rpm, and the horsepower curve begins to soar, topping out at 190 hp at 7200 rpm. The rush that goes with the onset of the VTEC effect is very much like a big shot of turbo boost, which is part of this car's very high fun-to-drive quotient.

The other part—the part that makes this car competitive against its higher-horsepower opponents, the Nissan 300ZX and turbocharged Mitsubishi Eclipse/Eagle Talon/Plymouth Laser—is its chassis. Honda's double-wishbone suspension system shows to very good advantage here, delivering exceptional handling. And the brakes, augmented by Honda's antilock feature, are simply outstanding.

One other element that boosted our effort after the early-season races was the arrival of the updated BFGoodrich R1 radial tire. Enhanced by stiffer sidewalls, a revised compound and a new asymmetric tread pattern, the redesigned R1 trimmed more than 1 second from our lap times and also exhibited improved wear characteristics. One of the keys to the success of the new tire is its built-in ability to compensate for camber changes, which helps to keep the outside front tire from rolling under during hard cornering. This is particularly important for a front-drive car, even one as sophisticated as the Prelude.

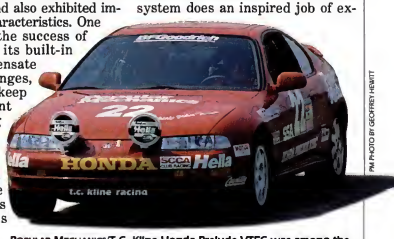
The first three races found us playing catchup to well-developed cars competing for the SCCA's Southern Pacific Division championship in SSA. We scored two seconds and a fourth. Then the new tires came along, and we also got a better idea of how to balance the car—via tire pressures—for different tracks. And from that point on, the results improved considerably.

When the regular-season dust had settled at Willow Springs on Labor Day weekend, we wound up with six wins in 10 starts, which was good enough for the divisional championship in SSA. Included in the tally were new SSA racing lap records at California's Laguna Seca and Sears Point Raceways.

We also ran a Prelude VTEC—prepared by T.C. Kline Racing—at the annual Longest Day of Nelson Ledges 24-hour race. Besides your humble narrator, the driving crew included Rich Ceppos, of *Automobile* magazine, SCCA Pro Solo champions Stacy Reitmeir and Bob Endicott and SCCA Northeast Division champion Seg Quinones.

Here, too, the Prelude showed to good advantage against more powerful opposition. We ran as high as second place overall before a broken halfshaft slowed us up.

This performance, combined with the car's excellence in sprint races, confirmed our preseason expectations and then some. Honda's VTEC system does an inspired job of extracting optimum horsepower from limited displacement, giving this car two distinct power modes without the complications of turbocharging. And the handling ranks with the best. It's an easy car to drive quickly, right out of the box, and unequivocally the best-handling front-drive car in our experience. PM



PM PHOTO BY GEOFFREY HEWITT

POPULAR MECHANICS/T.C. Kline Honda Prelude VTEC was among the front-runners at the 1993 Nelson Ledges 24-hour race.

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MUSIC MANAGEMENT

BY MURRAY SLOVICK

● You've purchased a 6-ft.-high CD storage tower that holds 200 discs, and now you're feeling in command of a burgeoning music collection. Great. But just as an experiment, see how long it takes to find and play, oh, let's say, Kenny G's sultry saxophone phrasing in *Forever In Love*.

If your collection is meticulously organized, perhaps according to artist and/or music type, and if you remember that *Forever In Love* is track two on the album *Breathless*, the search might only take a few minutes. Otherwise, trying to sort through dozens, if not hundreds of discs to find a particular selection could prove more complicated than listening enjoyment ought to be.

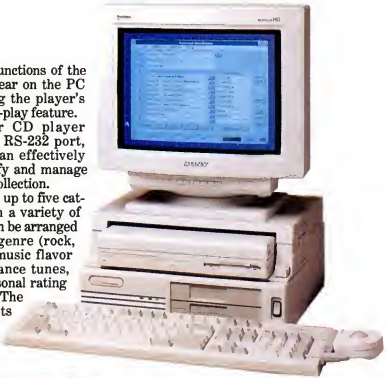
Fortunately, the people who devote their professional lives to producing compact-disc gear and those who do computer programming spent a little time together recently thinking about how to use a PC to better organize and play CD music.

Computers can control CDs basically because every CD has its own digital identification code. PC software, in turn, can be used to track discs and determine the number and length of each track. Detailed information, such as album titles and song names, however, aren't recorded in binary code, so you generally have to enter this information yourself.

One of the most innovative pieces of CD-related control software is from Kenwood. Called "MoodMaker," this is a database software program working in the Windows environment for the cataloguing and control of disc collections ranging from 230 into the thousands. Plugged into Kenwood's own DP-M7750 6-disc CD changer, which features an RS-232 port, an on-screen Windows icon controls playback of a disc or disc magazine. All of the functions of the CD changer appear on the PC screen, including the player's 700-entry shuffle-play feature.

Even if your CD player doesn't have an RS-232 port, "MoodMaker" can effectively inventory, classify and manage your entire CD collection.

You can create up to five categories based on a variety of criteria. Music can be arranged by artist, title, genre (rock, classical, etc.), music flavor (heavy metal, dance tunes, etc.) or by a personal rating number (1 to 5). The software then lets you select from one or more categories.



Manage your CD collection by computer using Kenwood's DP-M7750 player.

A batch of other PC-based CD organizers require sound boards and CD-ROM drives, which only can be used to play music discs on drives with the appropriate audio decoding circuits. The most well-known PC sound-board products are the Sound Blaster line from Creative Labs. Sound Blaster's Pro board features a voice music synthesizer, a MIDI adapter cable and sequencing software. (MIDI is a communications standard that permits the exchange of data and music between musical instruments and computers.) Sound Blaster Pro can provide full CD-quality sound sampling—16 bits at 44.1 KHz.

"Music Box" from Trantor Systems (Fremont, California) is a software package that not only allows you to set up a CD database for preferred-track sequence information, but provides a home-stereo-like on-screen interface for using CD-ROM drives to play audio-only CDs.

The $39 software package duplicates CD-player controls on screen, with STOP, PLAY, PAUSE and SHUFFLE controls, as well as programmable track play. In fact, "Music Box" is easier to set up than some CD players.

Omni Labs' "AudioMaster" provides an on-screen CD player and jukebox for either the Windows or DOS environment. Click the Windows CD-player icon and a CD control panel appears on screen. All the CD player's functions are mimicked on screen. If there is no disc in your player, the CD tray on the screen slides out from the player. When you insert a disc, the tray slides back in. PLAY, FORWARD and REVERSE

One hundred CDs are stored on a carousel inside this Sony player.

functions are provided with the current track and time appearing on the CD player's display. SHUFFLE and REPEAT play modes also are available. And if your CD drive is electronically controlled, pressing EJECT will cause your player to eject the disc. "AudioMaster" comes with a joystick port, microphone inputs and stereo outputs.

"Animotion" (Birmingham, Alabama) has a Windows 3.1-compatible stereo interface that looks like a dream audio system. The animated drawer of the pictured CD player on screen opens when you click on EJECT. A scanning volume control and a host of on-screen functions allow you to use the sound capabilities of Windows 3.1 to turn your PC monitor into a stereo control system.

"Animotion" also lets you add special effects to musical selections and catalogue a music library, loading up to 99 selections at once.

The on-screen "component rack" stereo interface in Digivox's "Sound Impression" (Palo Alto, California) includes volume and balance settings for all devices, a CD player to listen to your favorite CDs while working in other applications, a digital wave file recorder/player and a sequencer for MIDI applications.

MIDI users may be interested to learn that JVC has developed a CD-plus-MIDI medium in which regular music signals and MIDI signals for operating electronic instruments are recorded on a single compact disc.

With CD plus MIDI, the musical instrument can be controlled in synchronization with the playback signal of the music, making possible a sort of instrument karaoke, where you play along with the recorded instruments, rather than sing.

If you don't have a computer but you do have a lot of discs and even more disposable income, Sony's easy to live with CDP-CK100 provides instant electronic access to 100 CDs stored internally on a carousel. An automatic disc-loading system is used, and a memory management system lets you electronically title discs in the player by one of 10 subcategories (Rock, Jazz, My Favorites, etc.). By using a jog dial, you can locate and call up any disc in the player. For infinite variety, a shuffle-play function is available. Word from Japan is the $1200 CDP-CK100 is the first of a series of 100-disc Sony players. Subsequent models will offer RS-232 ports for external computer control, allowing software to take the place of the programming electronics and reducing the cost of these CD jukeboxes to consumers. **PM**

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FUTURE GAMES

BY JAMES K. WILLCOX

● Almost from the very beginning, new technology has been the horse that videogame companies have ridden to mass popularity. Nintendo's NES system, for example, was a demonstrable improvement over Atari's early 2600 unit, and it left a whole new generation of finger-sore adolescents in its wake. Similarly, the advent of 16-bit systems in the early 1990s attracted the next wave of players with near-arcade-quality action and graphics.

History may be about to repeat itself. By the time the new year rolls around there's not only going to be a new horse in the corral, there'll be a few new ways to ride the old one, too.

Since 8-bit systems evolved into 16-bit systems, the logic said that the next wave of game machines would be 32-bit systems offering double the performance of current game consoles. With the introduction of a new 64-bit system this fall, however, Atari Corp. plans to leapfrog ahead to a device it says is four times as powerful as Nintendo's and Sega's present systems.

Called the Jaguar, Atari's next-generation system should sell for just under $200, though the optional CD-player accessory—which is needed for advanced games and to play audio CDs—will cost another $200.

For that $400, however, Atari says you get the world's first 64-bit multimedia entertainment system, which, based on the system's architecture, should be capable of impressive videogame performance.

At the heart of the system is a 64-bit Reduced Instruction Set Computer (RISC) processor, which enables the system to rapidly make numerous, specific types of calculations. This allows the system to scale and rotate on-screen sprites and polygons for realistic 3D effects and motion. Because of the system's power, shaded 3D polygons can be created on the fly, meaning on-screen characters and objects can be rendered in real-time as the game progresses. On-screen characters look more real and move more realistically as a result.

Atari says Jaguar's added horsepower also will allow it to "texture map" graphics, a process by which either realistic computer-generated drawings or digitized photos can be "wrapped" like cellophane around a polygon, giving the object or character a more lifelike appearance.

Jaguar will also offer a palette of more than 16-million colors. By comparison, Nintendo's Super NES has 32,768 colors available, while Genesis offers 512.

Atari's optional CD-ROM peripheral for Jaguar will be a double-speed CD drive, spinning at twice the speed of a standard CD player. This allows the Jaguar to transfer data more quickly and reduces the time it takes to access game information.

In addition to playing CD-ROM games and entertainment titles, the CD accessory will play conventional audio compact discs, CD-Graphics discs, which are sometimes used for karaoke, and Kodak's new Photo CDs.

Since sound is an important component in multimedia systems, Atari is using a digital signal processing (DSP) chip to provide CD-quality stereo audio to reproduce music soundtracks, sound-effects and real voices. A built-in 32-bit expansion port will allow Jaguar to be connected to cable and telephone networks in the future.

Nintendo, meanwhile, plans to up the numbers ante. The company plans to market a 64-bit RISC-based system for less than $250 by late 1995. Dubbed "Project Reality," the system is a joint effort with Silcon Graphics, a maker of high-speed workstations.

The Edge

Next spring, Sega is shipping a virtual-reality accessory for Genesis called Sega VR, essentially a headset containing a tracking device, a color display and stereo headphones. By strapping on the Sega VR headset, you are plunged into a "virtual" 360° gaming world in which action can—and does—come from all directions.

Sega VR will sell for approximately $200, and at least four specially designed games—a shooter, a flying game, a driving game and an action/adventure title—will be available.

Sega's The Edge 16 (top) and SN's programmable controller.

Another Genesis accessory, called The Edge 16, will allow Genesis players anywhere in the country to compete head-to-head via telephone lines. Developed by AT&T and P.F. Magic, The Edge 16 is expected to sell for between $100 and $150, depending on the configuration.

Using The Edge 16, Genesis owners not only will be able to compete against each other, they'll be able to speak to each other during the game. The device, which adds an additional 128K of RAM to Genesis's main memory, will have four slots for additional game-enhancement cards to extend and customize games or to store game information.

Flying Games

Thanks to a new project called the Nintendo Gateway System, travelers on airplanes and cruise ships or in hotel rooms will now have access to games and other services.

The Nintendo Gateway System is powered by a Nintendo 16-bit Super NES processor goosed with additional communications functions, allowing the device to offer games, CD audio, telephone, shopping and informational services.

Airplanes will feature a reduced-size Super NES and an LCD television screen built into the seatbacks. Passengers can choose from 10 different SNES games, movies, audio compact discs and telephone and shopping services.

Power Plug: Multiple actions, one stroke.

Expect to pay about $4 per hour for these services. Games are available at any time, but movies are only available at preset times since they are provided by on-board Super VHS or Hi8 VCRs. New games are loaded onto an on-board hard drive at the beginning of every flight.

The system is already operational on one Northwest Airlines jet, and at least 20 planes should be equipped by the end of the year.

For hotels and cruise ships, the system will act as a bedside controller for movies and games, and it will also provide information on room accounts, restaurants, shopping and recreational activities.

Better Controllers

As videogame technology advances, the games are getting increasingly complex, and they are requiring complicated moves that are difficult for the player to master.

To address this problem, several companies, such as STD and Ascii, now offer controllers that enable special—and often complex—multiple moves that can be triggered by a single button.

Games like Capcom's popular "Street Fighter II" require players to push a number of different buttons simultaneously every time they want to perform a special move. By using STD's SN Programpad or SG Programpad controllers, once that sequence is performed, it can be repeated anytime at the push of one button. Action sequences, variable slow-motion functions and independent auto-fire features for shoot'em-ups appear on the LCD control panel.

Similarly, the Power Plug from Tyco Toys allows you to program up to 20 complex moves and activate them simultaneously with the touch of one button. List price for 16-bit machine controllers is about $40. PM

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PHOTOGRAPHY

SAVING OLD IMAGES

BY GEORGE SCHAUB

FILM PHOTOS BY DON COCHRAN

● It's entirely possible that an entire generation of family memories, in the form of still color pictures, may be lost. While you may enjoy the black-and-white pictures of your grandparents, and in some cases great-grandparents, that visual and emotional connection may not be there for your children and your children's children.

Why? Because of the instability of certain color photographic materials. Is there a way to protect and preserve those images? To find out, let's first get to the root of the problem, and then find ways to stem the destructive tide.

Color photographic images are formed by dyes, which replace the original light-sensitive silver in the film during processing. As the notice on the film box states, "Since color dyes may change over time, this product will not be replaced for, or otherwise warranted against, any change in color." For some types of color photographic materials, especially those manufactured in the early 1950s through the mid- to late-1970s, this is a vast understatement. Anyone who has collections of color prints and films from that era knows this to be true. Certain color dyes that make up the print have faded or discolored and many prints have become hopeless cases. And, that disappearing act doesn't stop—it continues until the image is gone.

Admittedly, color materials today are more stable than those of the

FILM PHOTOS BY GEORGE SCHAUB

The pool player (top right) fades after being in the sun for 30 days. From the 1950s: Kodachrome (bottom left) holds true but Ektachrome (bottom right) does not.

past—what we're generally talking about here are those color pictures made 10 to 15 years, or longer, ago. However, even today's color pictures are subject to problems, and even though they last longer, they have nowhere near the lifespan of black-and-white pictures, especially those processed carefully and printed on fiber-based papers.

There have been particularly notorious cases of color photography's instability. In a landmark book published this year (*The Permanence And Care Of Color Photographs*, by Henry Wilhelm, with Carol Brower, Preservation Publishing Co.), researcher Henry Wilhelm relates the tale of mall portrait photographers who, throughout the 1970s and early-1980s, photographed and sold millions of portraits to families throughout the country. According to Wilhelm, "All of the millions of...portraits... [from] that period have now faded to an unsightly red color, regardless of whether they were displayed [hung on the wall] or kept in the dark [in albums or drawers]."

PM PHOTO BY F. CLAPSADDLE.

This black-and-white image is 120 years old.

While instability may be inherent to certain color photographic materials—and some, according to Wilhelm, are far worse than others—the way in which those films and prints are stored can contribute even more to the problem. Certainly, with virtually any color image, exposure to direct light is highly detrimental. Coming in a close second is exposure to high heat and humidity, with the combination of the two being particularly deadly.

Color slide film also has its problems. For years, Kodachrome has been known as perhaps the most stable form of color material. Indeed, Kodachrome slides my father took of me and my brother in the early-'50s hold their fidelity even today. However, if you like to project your slides, Kodachrome becomes quite unstable, especially when subjected to frequent slide shows. In fact, it is even less stable than the other slide films under those conditions. So, advises Wilhelm, if you shoot slides to project them, shoot another film. But if you shoot for the family archives, and will store the film in the dark, Kodachrome's the way to go.

While the news from the researchers and archivists is not encouraging, there are ways in which precious family pictures can be protected. The first step is awareness—know that images are fallible and subject to deterioration. Once that is accepted, understand that the way in which images are stored has a major effect on their longevity. And finally, given the above, be prepared to copy old prints, and to make prints from old negatives, every few years.

When should you begin to make copies? It will depend upon the material on which the original image had been made. But a telltale sign is the loss of color fidelity, or the fading of certain parts of the image. Some materials will discolor toward magenta, others toward yellow. Once you see a shift in either direction, decide whether the image should be salvaged, then have a copy made. Fading generally begins in what's called the highlight, or brightest area of the image. While color shifts will usually begin first, or accompany the fading, the loss of information in the bright areas of the picture is a sign of degeneration that should be noted.

While the picture loss is easy to read, the degradation of the negative is often tougher to notice, mainly because of the orange mask that covers the reversed image. If you keep negatives and prints in the same storage area, or have some form of cross-reference guide, let the prints be your guide, or check the negatives occasionally and compare them with more recent negatives. If they seem to be comparatively faded or weak, make a test print from one and check the results.

All this means checking your picture albums and storage containers periodically. There's nothing quite like the shock of opening an album that has been sitting in the closet for a few years and finding prints that have discolored or have begun the big fade. Maintenance is key here.

These are sobering thoughts, but matters to consider should passing images from one generation to another be important to you. PM

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 (Continued from page 46)

Subaru Impreza Sport Wagon

With just over 5000 miles, our Impreza goes about its daily duties without fuss or problems. Though the mileage may seem low, it includes a great deal of city driving.

Certain features have won praise from our drivers. Maneuverability is one: The Impreza makes its way through traffic with ease, thanks to light steering and good visibility. Another plus is the a/c system, which did a better-than-average job during a recent West Coast heat wave.

The Impreza's flat-Four engine has grown smoother as the miles have rolled by, and so has the shift linkage in the 5-speed manual transmission. The only required service to date was an oil and filter change at 3000 miles. This service was inexpensive, as nothing else needed adjustment or replacement.

Fuel consumption, however, has varied considerably with driving conditions. In day-to-day use, the Impreza does well, averaging better than 22 mpg. During rapid freeway travel, though, we've seen mileage drop down toward the 20-mpg mark. We believe 2-wheel-drive Imprezas —ours has awd—should do better.

Still, the Impreza has been impressive so far. To call it more sensible than sporting is no criticism. To give it top marks for comfort, reliability and utility is no overstatement.

—Ray Thursby

Mazda 626 ES

At 4914 miles, it's clear that the Mazda 626 ES is habit forming. It's one of those gratifying cars that makes you look forward to driving, regardless of destination. Short haul or long, the 626 makes the business of driving more fun than a good many other cars.

The ES trim level includes Mazda's 2.5-liter dohc 24-valve V6, and in our car it's mated to a very precise 5-speed manual gearbox. As we noted in our first report, this engine is deceptively potent. And the car that surrounds it is deceptively agile. It may be the sportiest setup in its class.

Now that the engine is thoroughly run in, our overall fuel economy is creeping toward the high 22-mpg range. We've accumulated almost all this mileage in and around L.A. There's only one open-road run—to Monterey—in the logbook so far. So we think the car's fuel efficiency is slightly above expectations—particularly in view of how tempting it is to punch the throttle. *—Tony Swan*

GMC Suburban SLE

The Suburban was conceived for hard work, and that's precisely what it's done during its year in the PM stable. Although it spent a fair proportion of its time parked in our L.A. garage, when it did leave, it was to embark on a long haul, usually with a trailer and race car hooked on behind.

We've made three major cross-country hauls, most recently to the Sports Car Club of America championship runoffs at Road Atlanta. And through all of this, our Suburban has performed flawlessly.

The 454-cu.-in. V8 hardly seems to notice when there's 5000 pounds of trailer and Honda Prelude hooked on behind. Aside from a 2- to 3-mpg drop in fuel economy—from 13 to 10 or 11 —it snorts along with the same hill-flattening determination. During its first 2000 miles, it tended to use a little oil, something we've noticed in other GM 454s. Now—with more than 20,000 miles on the clock—it uses none.

At $31,000-plus, our top-of-the-line 4wd SLE Suburban isn't exactly cheap. But as an all-around workhorse, we think it's worth every nickel and more. Although the full-size utility field is becoming a little more populous, there's still nothing that can match the versatility, durability and comfort of the Suburban. *—T.S.*

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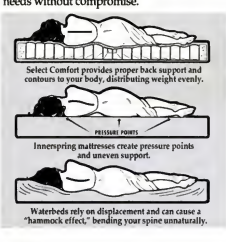

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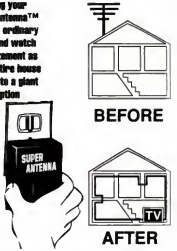

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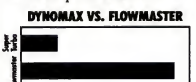

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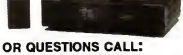

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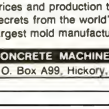

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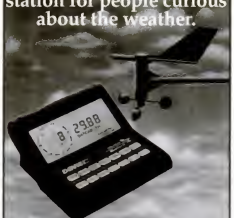

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